Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

CALIFORNIA DESERT AGRICULTURE

N. L. MC FARLANE
R. S. AYERS
G. L. WINRIGHT

CALIFORNIA AGRICULTURAL
Experiment Station
Extension Service

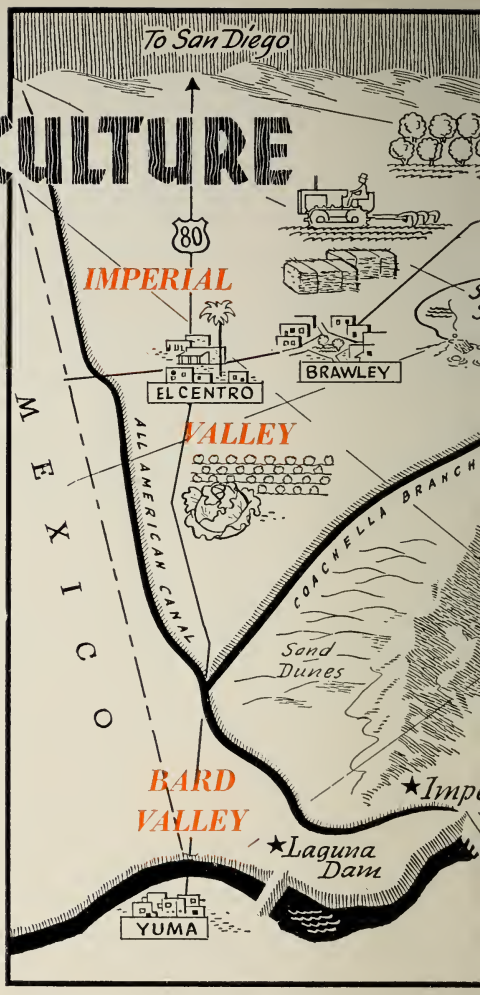
CIRCULAR 464

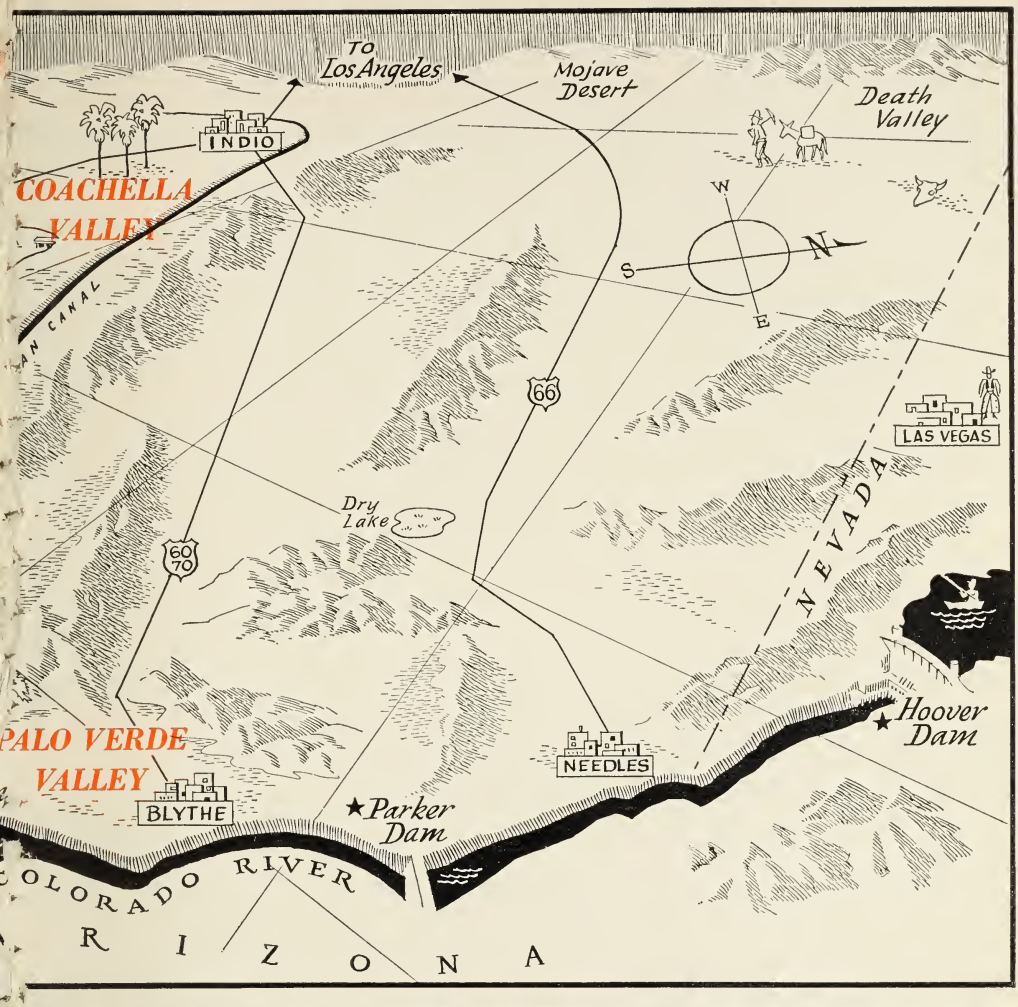
THE KEY TO

DESERT AGRICULTURE

IS WATER

The California Desert as depicted in the artist's conception map was for hundreds of centuries an arid waste inhabited only by a few Indians who hovered around water holes and streams and who became expert in finding sustenance in an inhospitable land. Modern technology has plumbed into the earth to find hidden water sources and channeled the unused water of the Colorado River into the thirsty desert. This new element, plentiful and inexpensive water, is the key to agriculture in the desert. With water, thousands of acres of desert have become green and productive. This publication describes the problems and the techniques of farming in the desert region.

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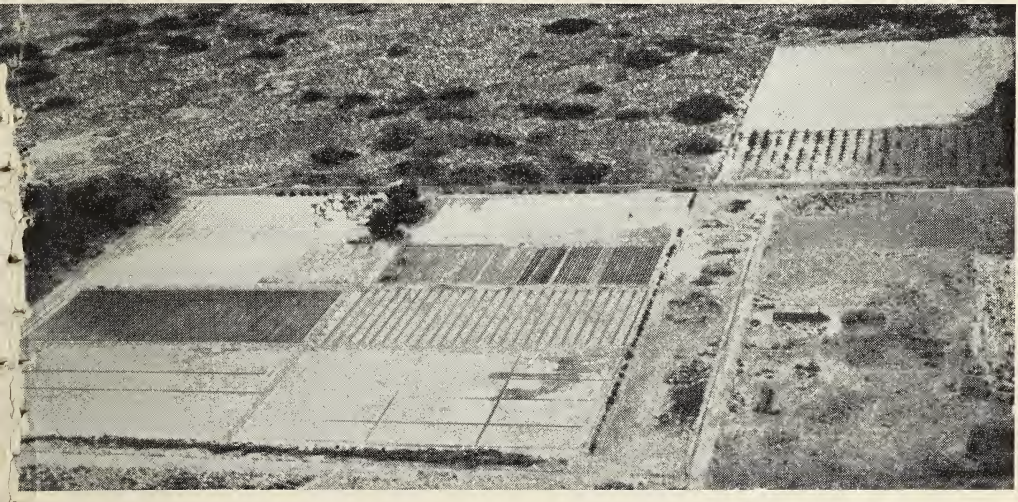

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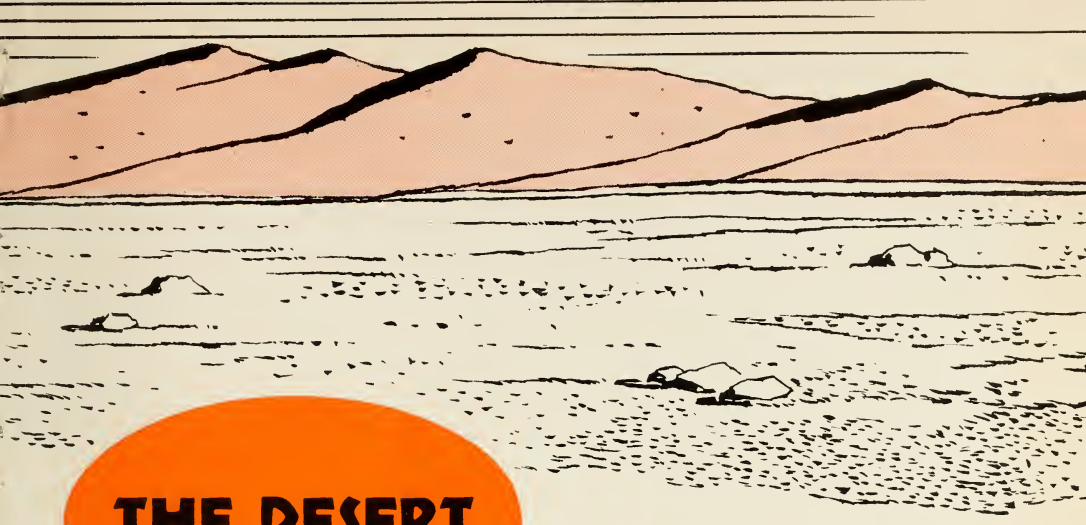
THE AUTHORS:

N. L. McFarlane is Farm Advisor, in Riverside County; R. S. Ayers was formerly Farm Advisor in Imperial County; G. L. Winright is Farm Advisor, Los Angeles County.

NOVEMBER, 1957



THE DESERT

About 60 years ago the southeastern part of California was a desert wasteland—hot, dry, sandy—and about the opposite of what was considered a desirable farming area.

Today, parts of this area produce food and forage crops valued in millions of dollars. This has been brought about by the introduction of that magic substance — water. Coachella, Imperial, Bard, and Palo Verde valleys have come into everyday use in the language of growers and distributors of agricultural products and are examples of what water can do for a desert area.

The change from a desert wasteland to a productive garden was accomplished in spite of the many difficulties encountered. Some of the uncertainties of living and raising crops or livestock in the area are still present and much of the remaining desert area still awaits reclamation. This circular, therefore, is designed to offer suggestions and recommendations for successful farming in this and similar areas.

The former California Agricultural Experiment Station Circular 334, "Soils and Crops of the Imperial Valley," by Stanley W. Cosby and L. Gordon Goar, has been freely quoted in this circular where the information was still applicable.

The climate of the area is what is known as desert subtropical and is characterized by high temperatures occasionally reaching a maximum of 125°F in the middle of summer. The temperature may reach 100°F or more any day from March through October. Even in the winter months, the temperature may rise as high as 85°F.

The winters are short and mild, with a large percentage of sunny days. Killing frosts seldom occur before the middle of November, or after the middle of March. Frosts may be expected from December 1 to February 15, and the annual frost-free growing season is about 300 days long.

The relative humidity is low during the greatest part of the year, a circumstance that makes the summer temperatures bearable even though they are unusually high. With the exception of a few short periods of relatively high humidity in late summer, the humidity is ordinarily higher during the winter and spring months than during the remainder of the year.

The annual average rainfall is between 2 and 4 inches. Rains are irregular in occurrence and there have been many years in which no rain at all was recorded for part or all of this area. The rains are seldom beneficial, and are often detrimental to crops.

The soils of the low elevation Desert Area are relatively recent in origin and are made up mostly of river and lake deposits. Coachella Valley soils were laid down by stream flows from the surrounding mountains. The Imperial, Palo Verde, and Bard valleys soils were derived primarily from the periodic flooding by the formerly silt laden Colorado River. Most of these soils are highly stratified. The surface soil textures range from loamy sands to heavy clays.

Crop adaptability, irrigation, and general farm management practices are, to a great extent, dictated by these variable soil characteristics. For a comparison of soils and their adaptabilities, see page 8, Key to Soils of Low Elevation Desert Area.

For efficient farming in the desert area, careful attention should be given to the following questions:

Is enough water of good quality available?

Colorado River water is at present available for irrigation of lands lying

Climatic Data from Representative Stations in the Region

	Imperial Valley BRAWLEY	Coachella Valley INDIO	Palo Verde Valley BLYTHE
Mean annual precipitation	2.57	3.20	4.05
Mean annual temperature	71.9° F	73.3° F	70.6° F
Mean daily maximum temperature (highest month)	107.8° F (July)	106.8° F (July)	107.8° F (July)
Mean daily temperature (highest month)	91.6° F (July)	93.0° F (July)	91.2° F (July)
Mean daily temperature (lowest month)	53.0° F (Jan.)	53.7° F (Jan.)	51.5° F (Jan.)
Mean daily minimum temperature (lowest month)	37.5° F (Jan.)	38.1° F (Jan.)	34.7° F (Jan.)
Earliest date of first killing frost after July 15	Nov. 15	Nov. 9	Oct. 18
Mean date of first killing frost after July 15	Dec. 9	Dec. 4	Nov. 23
Mean date of last killing frost before July 15	Feb. 3	Feb. 7	Feb. 17
Latest date of last killing frost before July 15	Mar. 5	Mar. 16	Apr. 8
Highest temperature	122° F (July)	125° F (July)	122° F (July)
Lowest temperature	19° F (Jan.)	13° F (Jan.)	5° F (Jan.)

Source: Weather Bureau, United States Department of Commerce Federal Office Building, San Francisco, California, by letter May 4, 1956.

Analysis of Colorado River Water* at Yuma, Arizona

†Electrical conductivity, EC × 10^3 @ 25° C	1.26
Boron, p.p.m.	.21
Per cent sodium	41
pH	8.0

	Equivalents per million	Parts per million
Dissolved solids (1.16 tons per acre ft.)	....	857
Calcium, Ca	4.89	98
Magnesium, Mg	2.88	35
Sodium, Na	5.61	129
Carbonate, CO_3	0	0
Bicarbonate, HCO_3	2.82	172
Sulfate, SO_4	7.37	354
Chloride, Cl	3.19	113
Nitrate, NO_3	.02	1

* Mean of 10 day composite samples (36 samples) collected at Yuma Main canal below Colorado River siphon for period January through December, 1955. Analyses by U.S. Geologic Survey.
† This electrical conductivity is expressed on the same scale as used in table "How Does Salinity Affect Different Crops", Page 10. Most water analyses are expressed as 10^6 in which case this figure would be 1260

within the boundaries of the irrigation districts serving each of the areas—Imperial, Coachella, Palo Verde, and Bard. All areas outside the specified irrigation districts must rely on a locally developed water supply, usually a well. Colorado River water is of satisfactory quality for surface irrigation of all crops except those very sensitive to salinity. Table above shows a typical chemical analysis of Colorado River water.

What is the level of the land?

Good land leveling assures uniform surface flooding and the uniform water distribution necessary to prevent accumulation of excessive concentrations of salts on high spots.

Land leveling practices vary within this region but the general types are of the following: (1) leveled to grade (1- to 2-foot drop per thousand feet of distance); (2) leveled flat and irrigated in basins five acres or less in size; or (3) rough leveled (for sprinkler irrigation).

Sprinklers are being used in some places where costs of complete leveling are considered prohibitive. In such cases a rough leveling of the land may be satisfactory.

Is there too much salinity or alkali?

In any irrigation water there are soluble salts which can accumulate in the soil. Some waters normally contain more salts than others. Colorado River water is good for irrigation but contains more than one ton of soluble salts per acre foot (see table). Therefore, each time an acre foot of water is applied, we are also adding a little more than a ton of soluble salts. If these salts were not forced below root level they would soon accumulate and slow down or prevent plant growth. The level to which salts have accumulated in any field can be determined by analysis of soil samples, usually made by qualified commercial laboratories. See your local University of California Farm Advisor for suggestions and sampling procedures.

See Key to Soils, page 8

Key to Soils of Low Elevation Desert Area

Surface texture	Subsoils	Soil name (series)	Location	Adaptation
Gravelly sands and sands.....	Sands	Superstition	Steeper outside edges of Coachella and Imperial Valleys.	Specialty crops (trees and vineyard) in best locations, most of this series is questionable for farming.
Gravelly sands.....	Clay	Niland	Northeast area of Imperial Valley, generally north of Niland.	Relatively frost free, winter tomatoes, early melons, squash and similar crops. Special uses.
		Superstition	Steeper alluvial fans around edges of Coachella Imperial, and Palo Verde Valleys.	Special handling of crops on these soils may be necessary due to excessive water, fertilizer usage, and wind erosion. Adapted to many crops if carefully farmed.
Sands to loamy sands.....	Sands to loamy sands	Coachella	Gentle slopes between valley bottom and surrounding hills.	Same as above.
		Rositas	Wind modified; scattered but fairly extensive areas throughout Imperial and Palo Verde Valleys.	Same as above.
Sandy loam to silty clay loam....	Clay loam to clay	Meloland	Scattered bodies throughout Imperial Valley.	Internal drainage restricted. Good general crop adaptation.

Very fine sandy loam to loam.....	Sandy loam to silty clay loam	Indio	Extensive in Coachella Valley	Well suited to all usual crops of the area.
Silty clay loam to clay.....	Sandy loam	Holtville	Extensive throughout Imperial, Palo Verde, and Bard Valleys.	Well suited to all usual crops of the area.
		Woodrow	Near Salton Sea in Coachella Valley.	Field crops. Inadequate water penetration for plant use and salt removal is a common problem.
Silty clay loam to clay.....	Silty clay	Imperial	Large areas of northeast Imperial Valley and lesser area in other parts. Small areas in Palo Verde.	Field crops and certain vegetable crops. Inadequate water penetration for plant use and salt removal is a common problem.

Leaching is the best way to remove accumulated salts. If this cannot be done, more salt tolerant crops may have to be grown or special cultural practices (such as slant beds) be adopted. Different crops tolerate different amounts of salt, and usually a crop can be planted adaptable to the salinity of a specific field. For a list of crop tolerances to salinity, see page 10, "How Does Salinity Affect Different Crops?"

Excessively high salinity must be reduced before profitable crops can be grown. Reclamation is generally accomplished by leaching. Leaching is usually accomplished by erecting an earthen dyke around the affected area, and ponding water. As the water drains into the soil it will carry the salts to a point beyond the reach of crop roots. When the salt concentration has been reduced sufficiently to again permit profitable production of the desired crop, ponding is discontinued, the land is allowed to dry and prepared for the crop.

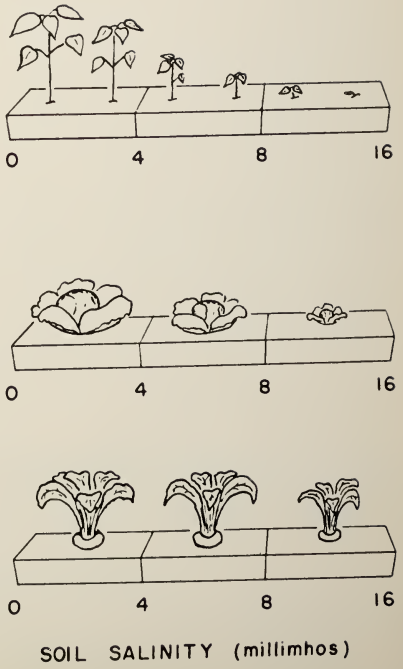
Alkali problems (excessive exchangeable sodium) are different from salinity problems, but salinity and alkali often occur together. The treatment and management practices of alkali soils are much more difficult to handle than salinity control. If you suspect alkali is a problem, consult your local farm advisor. Some alkali is known to exist in Coachella and Palo Verde valleys, but no important alkali areas are known in the Imperial or Bard areas.

What about Drainage?

Without drainage, the water table builds up and salinity problems develop rapidly. In growing alfalfa in the desert area, farmers commonly apply 5- to 6-acre feet of water per acre per year. For the areas using Colorado River water, this means that more than 5 or 6 tons of salt are applied to each acre each year. Most of this salt is undesirable or

HOW DOES SALINITY AFFECT DIFFERENT CROPS? SOME ARE AFFECTED MUCH MORE THAN OTHERS

	Field Crops	Vegetable Crops	Forage Crops	Fruit Crops
Sensitive*	Field beans	Green beans Celery Radish	Ladino clover White clover	Lemon Peach Apricot Plum Grapefruit Orange Apple Pear
Moderately* tolerant crops like	Flax Corn Sorghum Oats Wheat Rye	Cantaloupe Cucumber Peas Onion Carrots Squash Peppers Sweet corn Lettuce Cabbage Broccoli Tomato	Vetch Orchard grass Tall Fescue Alfalfa Sudan grass Dallis grass Sweet clover	Grape Olive Fig Pomegranate
Tolerant* crops like	Cotton Beets Barley	Spinach Asparagus Kale Garden beet	Bermuda grass Salt grass	Date



* Listed with most sensitive crops at top and most salt tolerant at bottom.

(The millimhos are the units in a scale of crop tolerances which scale has been correlated to plant growth)

This data adapted from U.S.D.A., ARS publication ARS-41-4 by Bernstein, Fireman and Reeve, titled "Control of Salinity in the Imperial Valley, California."

unnecessary. To prevent excess salinity, enough water must be applied to carry these salts down through the soil and out of the root area. This means more water must be applied than is needed by the plants. In the absence of good drainage, the excess accumulates and water tables are formed close to the soil surface. If such water tables do build up to within 5 feet of the ground surface, they usually reduce crop yields. Water tables can be lowered by constructing open drains or covered tile drains at spacing dependent upon soil characteristics.

The several soil survey reports of these areas prepared by the U.S.D.A. have supplemental maps giving an indication of the salinity conditions in the soil at the time of the survey. These reports can be seen in the Agricultural Extension Service office or in the public libraries in the area.

Relatively large portions of the desert area have built up salinity levels high enough to make growing of crops difficult or impossible.

The following publications give information on the relative tolerance of crops to salinity; the effect of salts on soils; and the reclamation of saline and alkali soils:

Control of Salinity in the Imperial Valley, California, U.S.D.A.-ARS-41-4; U.S.D.A. Misc. Publication 607; *The Salt Problem in Irrigation Agriculture*, U.S.D.A. Cir. 707; *Saline Soils, Their Nature and Management*, by O. C. Magistad and J. E. Christiansen; *The Reclamation of White Alkali Soils*, California Experiment Station Bulletin 617*, by W. P. Kelley; *Reclamation of White Alkali Soils in Imperial Valley*, California Experiment Station Bulletin 601*, by Ed E. Thomas; *Soil Salinity in Relation to Irrigation*, *Hilgardia*, Vol. 18, No. 18*, by W. P. Kelley, B. M. Laurence, and H. D. Chapman.

* Out of print, but available at many libraries in California.

There are no chemicals which can be applied to the soil to remove or change the salts so that crops can be grown successfully. Removal of soluble salts from the soil by leaching is the only practical method of reclaiming saline soils.

The application of gypsum, agricultural sulfur, or sulfuric acid may hasten the reclamation of alkali soils, BUT ONLY IF USED IN CONNECTION WITH LEACHING. The places where these agricultural minerals will hasten reclamation, when used in conjunction with leaching, are few in number in this region.

What makes Irrigation Different in this Area?

Generally irrigation of crops under the desert climate follow the same principles which apply to irrigation in other areas. However, lack of effective rainfall; relatively high temperatures; low humidity; and salt content of soils and water make it necessary to vary irrigation practices in the desert.

The lack of effective rainfall requires irrigation during the entire crop growing period. In the desert irrigation is a year round proposition.

Low humidity and high temperatures result in high rates of water usage. In the summer, a good stand of alfalfa has been estimated to use up to a half acre inch of water per acre per day. To prevent wilting it may be necessary to irrigate alfalfa every 5 to 8 days during the summer months. In the winter, irrigation intervals may be lengthened to 3 to 4 weeks for alfalfa.

More frequent irrigation is required for salty soil. The salt content of the soil has an important bearing on the water available to a crop. With salt present, the amount of water available to the plant is reduced. Therefore, irrigations must be more frequent.

A note on sprinklers—Losses of water due to deep percolation may be reduced by use of sprinklers. Sprinkler irrigation, however, is relatively new in the area. It is particularly well adapted to the sandy soils which allow too much water to percolate into the area below the roots when flood irrigation is used and to rough lands where leveling costs are prohibitive.

Sprinklers in the desert area will generally increase the labor requirements for a given crop. Also, since sprinklers operate under pressure, considerable power is required. *Recent research indicates that sprinkler irrigation of citrus orchards with Colorado River or similar water may result in partial defoliation of the leaves on the sprinkled portion of the tree due to sodium and chloride accumulation.*

What special techniques does desert farming require?

Fertilizers are used in large amounts. Desert soils generally require nitrogen and phosphate fertilizers. They are usually well supplied with the other major nutrients required for high crop production.

Except for legume crops desert soils generally require nitrogen at relatively high rates for profitable production. Rates of nitrogen applied to crops vary from a low of about 60 pounds actual nitrogen per acre on cereal crops to as high as 200 pounds or more on cotton, sugar beets, and many vegetables. In general, applications *early in the growth period* are more efficient than those applied later. More efficient use of nitrogen in crop production will result from me-

Crops can be protected against occasional frosts by using protective coverings of kraft paper. In this picture a farmer near Niland, warned of a sudden frost lays a second sheet of paper over his tomatoes to completely cover the plants. The back sheet helps early plantings by reflecting heat from the ground to the plants.

chanical placement (injection or drilling) than from applications in water. There is little carry-over of nitrogen from one crop to the next.

Phosphorous fertilizers have been used on vegetable and field crops for many years with good results. Tree and vine crops, however, have not shown appreciable benefit. Best results on annual crops are obtained from applications made ahead of planting. For flat planted crops, the phosphate is worked into the soil surface; for crops grown on raised beds, it is broadcast on the ground surface before beds are formed. The listing (forming) of beds then puts a portion of the phosphate close to the seed row and leaves part on the old soil surface. A more marked response to phosphorous is obtained on winter grown crops than on summer.

See table on page 14 for more complete data on typical vegetable crops and rates of general fertilizer usage and table on page 15 for some typical field crops.

Wind protection

The sandy soils in the Coachella, Imperial and Palo Verde valleys are all subject to blowing. Wind presents more of a problem in the Coachella Valley than in the other valleys.

March through June are the windiest months although severe winds occur occasionally in fall and winter. In the Coachella Valley most of the erosive winds come from the northwest. In the Imperial and Palo Verde valleys these winds generally come from the west. Experience elsewhere indicates that when the areas are fully developed the winds will be subdued somewhat.

Windbreaks of any kind give reasonable protection for a distance amounting to about ten times their height. Trees, particularly Athel or Tamarisk (*Tamarix aphylla*) are often used as windbreaks.

To prevent tree root systems from developing in the feeding area of adjacent crops, lateral roots should be pruned occasionally to 48 inches with a subsoiler or chemicals. Bamboo (*Phyllostachys aurea*), castor beans and many other trees and shrubs, make fair windbreaks. Palm fronds wired together are frequently used as windbreaks for vegetable plantings.

Barley, oats, hog millet and other cereals can be planted between grape and tree rows for wind protection.

Barley or oats drilled 20 pounds per acre and fertilized with nitrogen, are frequently planted immediately before alfalfa planting. After the cereal is two to three inches high the alfalfa seed is then drilled. While this takes two drilling operations, a "blowout" of the expensive alfalfa seed may thus be prevented.

A solid row of the field-planted tree crop is often used as a windbreak.

Crops grown in the desert. A good idea of the diversification of crops found in the desert valleys may be had by referring to the list on pages 16 and 17.

In addition to the crops listed, there are large numbers of cattle and sheep finished in this region, and some production of dairy cattle and hogs.

Since climatic and other conditions in the region are to some extent unique, the cultural practices involved differ in many respects from those employed in other parts of the state. Suggestions for successful raising of crops and livestock are given in the discussions and tables which follow.

The tables on the following pages will aid you in understanding agricultural operations in the desert.

Suggested Fertilizer Rates for Certain Typical Vegetable Crops

	Nitrogen (Lbs. actual N per acre)	Applied	Phosphate (P_2O_5 per acre)	Applied	Remarks
Lettuce:					
Early season (Plant late Aug. and Sept.) (Harvest Nov.–Dec.)	30 lbs. N	Pre plant	120 to 160 lbs. P_2O_5	Broadcast before beds are listed	Phosphate applied at thinning time or later is of little or no benefit.
Mid-season (Plant October) (Harvest January)	120 lbs. N	⅓ pre plant and rest side placed at thinning	120 to 160 lbs. P_2O_5	Same as above	Actual tests by U.S.D.A. at Brawley indicate more efficient usage of phosphate when broadcast before listing of beds. This is a type of placement.
Late season (Plant November) (Harvest February–March)	120 to 160 lbs. N	⅓ pre plant and rest side placed in one or more applications	120 to 160 lbs. P_2O_5	Same as above	
Melons	60 to 120 lbs. N	Usually in two or more applications	80 to 120 lbs. P_2O_5	Broadcast before making beds, or side placed before planting	Nitrogen requirement not high. Excessive N may reduce yield.

Suggested Fertilizer Rates for Certain Typical Field Crops

Alfalfa	Nitrogen not generally beneficial	Sometimes N is applied pre plant to aid barley or similar nurse crop for alfalfa	100 lbs. P_2O_5 pre plant. 50 lbs. annual thereafter	Broadcast or drilled	Annual applications made in fall aid growth in cool weather.

Cereals (Barley, wheat, oats)	80 to 120 lbs. N	All pre plant except on sandy soils in which case split into two	Can usually depend on carryover from phosphate applied to other crops in rotation	.....	Barley is often grown as 2nd crop. If following vegetables, little nitrogen will be needed. If following cotton or sorghums, 120 lbs. N or more may be needed for normal yield.
Cotton	120 lbs. N or more	1/3 pre plant and remainder in one or more application	Need for phosphate or rate of application not established. 40–80 lbs. P_2O_5 should be adequate	Broadcast before beds are listed	Warm weather crops appear to have lower requirement for applied phosphate than do cool weather crops.
Flax	80 to 160 lbs. N or more	1/3 pre plant, rest in one or more application. If more than one, an application is usually made at start of bloom period.	Rates of P_2O_5 not established by tests but 80 to 120 lbs. P_2O_5 is usual rate	Broadcast before irrigation prior to planting	Adequate nitrogen is essential for high yields.
Sorghums (Grain and ensilage)	100 to 120 lbs. N	All pre plant except on sandy soils in which case split into two	Depend on carryover from phosphate applied to other crops in rotation	.....	Sorghums are grown as second crop. Fast, rapid growth; responds well to early nitrogen. Warm season crop.
Sugar Beets	160 lbs. N or more	1/3 pre plant and remainder in one or more application. Apply all N before cold weather.	80 lbs. P_2O_5	Broadcast before beds are listed	Deficiencies of nitrogen are much more common than those of phosphate. Early N applications most beneficial. Late N may lower sugar percent.

The above fertilizer suggestions are based on field tests by Farm Advisors of Riverside and Imperial Counties, and on research conducted by personnel of the University of California Imperial Valley Field Station, Meloland, and U.S.D.A. Southwest Irrigation Field Station at Brawley, California.

1956 Crop Acreages in the Desert Area*

Field crops	Imperial	Coachella	Palo Verde
Alfalfa—hay	173,981	7,300	24,000
Alfalfa—seed	†35,000	....	1,156
Barley	79,873	1,850	3,200
Beans (Soy)	1,015	....	1,000
Bermudagrass	655	....	....
Broom corn	....	650	....
Clover (Berseem)	35	....	....
Clover	328	....	120
Corn—field	400	....	1,300
Cotton—long staple	....	....	140
Cotton	3,153	5,385	13,860
Flax	40,448	....	120
Grain sorghums	815	....	6,350
Hegari	608	....	....
Millet	260	....	....
Oats	1,778	20	920
Pasture	393	350	250
Rice	60	....	....
Sesbania	....	....	240
Sudangrass	152	....	....
Sugar beets	40,359	....	....
Sugar cane	3	....	....
Watergrass	80	....	....
Wheat	1,282	....	850
Wheatgrass	2	....	....
Totals	380,680	15,555	53,506
Trees and Vines			
Citrus—Grapefruit	872	4,809	....
Lemons	263	377	....
Limes	....	60	....
Misc.	....	115	....
Mixed	108	....	10
Nursery	105	75	....
Tangerines	230	960	....
Valencieas and Navels	345	77	....
Dates	115	4,538	3
Figs	....	25	....
Grapes—Thompson	....	8,395	....
Cardinal	....	598	....
Malaga	....	25	....
Ribier	....	137	....
Perlette	....	1,681	....
Delight	....	102	....
Beauty Seedless	....	170	....
Others	311	61	27
Pecans	114	34	....
Plums	....	6	....
Totals	2,463	22,245	40

* Agricultural Commissioner or Irrigation District reports.

† Part of hay acreage.

1956 Crop Acreages (Continued)

Field crops	Imperial	Coachella	Palo Verde
Vegetable crops			
Asparagus	571	197	6
Beans, snap	31	416	....
Beans (Windsor)	48	....	....
Beets	37	16	....
Broccoli (seed)	43	30	....
Cabbage	1,037	14	90
Cantaloupes	7,726	159	5,470
Honeydews	....	30	1,750
Honeyballs	295	....	50
Casaba	....	....	85
Persian	94	....	95
Crenshaw	....	10	120
Carrots	4,779	1,300	....
Cauliflower	4	....	....
Corn—sweet	....	4,720	120
Eggplant	....	186	....
Flowers	51	30	....
Garlic	539	....	....
Lettuce	32,468	....	7,087
Lettuce (seed)	158	....	....
Okra	....	132	....
Onions (dry)	834	101	120
Onions (green)	....	176	....
Onions (seed)	39	....	....
Peas	108	20	....
Peppers—Bell	....	407	....
Chili	....	66	....
Potatoes	311	....	....
Roses (rootstock)	1	....	....
Squash—summer	848	209	12
Squash—other	65	70	60
Sweet potatoes	11	203	....
Swiss Chard (seed)	8	....	....
Tomatoes, fresh	4,367	886	65
Cannery	5,000	....	....
Turnips	....	65	....
Water Lilies	6	....	....
Watermelons	5,641	100	3,300
Totals	65,120	9,543	18,430

FIELD CROPS

Field crops are particularly important in the Imperial and Palo Verde valleys. In the Imperial Valley they occupy nearly 380,680 acres, or about 83 per cent of the area under cultivation. In the Palo Verde Valley, field crops take up almost 74 per cent of the cultivated area. They are expected to increase in importance in the Coachella Valley as more land is brought under cultivation.

Alfalfa (*Medicago sativa*) for hay production is one of the largest field crops in the four valleys. It fits well into a rotation program with other field crops or vegetables and is raised for seed.

The climatic conditions of the desert area are almost ideal for the production of alfalfa, and when good cultural and irrigation practices are used, crop failures in the region are few. In the Imperial and Palo Verde valleys alfalfa has varied from one-fourth to one-half of the cultivated acreage.

Varieties. Africa, Common or Chilean are the alfalfa varieties generally grown in the area. Africa is well adopted to short rotations (2–3 years) and will yield about 10% more hay per acre per year than common Chilean for the first two years.

Soils needed. Alfalfa will succeed on a wide variety of soil types, but the loamy soils are preferred. The extremely heavy clay soils are least desirable and require attention to assure adequate water penetration.

Land preparation. Land must be carefully leveled for border check or "flood irrigation." Most common grade is 1.5 feet per 1000 feet, though in some instances the grade is essentially flat. See University of California publication "Border Method of Irrigation." After the land is leveled, it is plowed or subsoiled, disked twice, floated or land planed, and the levees or borders are made. A final "floating" between the levees is done and the land is ready for seeding.

Seeding. The necessity of preparing a good seedbed cannot be overemphasized. A very fine dust mulch or a very cloddy condition should be avoided.

Drilling or broadcasting the seed is used. Drilling will ordinarily produce

thicker, more even stands. Shallow planting, resulting in the seed being from ½ inch to 1 inch deep, is desirable. Most of the alfalfa in the area is irrigated up. Because sudden hot or windy periods are common in the fall or spring, farmers are prepared to irrigated every third day until the plants are through the ground.

Alfalfa is planted anytime from September to March; successful experimental plantings have been made in the summer. Fall plantings, October 1 to November 15, are preferred because the tonnage of hay produced the following summer will be far greater than from spring seedings. Most of the annual weeds can be controlled by mowing. On very weedy fields, particularly those heavily seeded with polygonum, a spring seeding may be best.

Seeding rates vary from 20–30 pounds of seed per acre.

Irrigation. Alfalfa for hay should never be allowed to get too dry. On most soils, 2 to 3 irrigations will be needed between cuttings during the warmer weather.

Many heavy soils (Imperial series and the Holtville clays) take water very slowly and accumulation of salts from the irrigation water may become a problem. During the winter when it is cool and the alfalfa plants are semi-dormant, it may be of benefit to use long, slow irrigations for leaching, which will help remove salts as well as get water into these heavy soils.

There is an increasing tendency in Coachella, Palo Verde and Bard valleys to make alfalfa land nearly level. Many fields have been leveled with only 1/10 foot fall in 660 feet. Where large volumes (heads) of water are available, 5 acres and even more are in one border check.

Life of stand. Alfalfa is plowed out after 2 to 5 years. It is often plowed up after 2 or 3 years production to be planted to vegetables. Alfalfa should reduce annual weeds for the succeeding vegetable crops. Frequent cutting when the alfalfa is in the bud stage or earlier, may shorten the life of the stand. Fields where a crop of seed is made yearly last longer than those continuously cut for hay.

Fertilizing. Alfalfa to be seeded on new land or land recently leached should be artificially inoculated with nitrogen-fixing bacteria. Under normal conditions it is not necessary to apply nitrogen fertilizer to alfalfa. On very sandy land nitrogen is sometimes applied to stimulate the seedlings and the "nurse" crop. In the Imperial, Bard, and Palo Verde valleys 100 pounds of P_2O_5 is commonly applied before planting and is followed by yearly applications of 50–80 pounds. Only parts of the Coachella Valley have a phosphorus deficiency consequently not all alfalfa in that area is phosphate fertilized. Fertilizer applications made before planting are disked or plowed in; subsequent applications are broadcast on the surface or applied in the irrigation water. Yearly applications are usually made from fall to January. Repeated trials have failed to show a response to potash in these areas.

Seed production is an additional enterprise for many alfalfa growers. Alfalfa for seed is allowed to grow and set seed after the May or June cutting. Alfalfa seed crops must be irrigated for best yields. Yields of 300–1,000 pounds of seed are common.

To produce a good commercial crop of seed, the alfalfa flowers must be

DISEASES AND PESTS

Control measures for diseases and pests are changing constantly, due to new discoveries.

For the latest recommendations on control measures, consult the local office of the

FARM ADVISOR

tripped by bees and cross-pollinated. This work is primarily done by the domestic honey bees but wild bees help. It is considered desirable to have at least one or more strong hives of domestic honeybees per acre in or around the alfalfa seed fields.

Insect control is essential for successful seed production. It would be well for the grower to check with his local farm advisor for the latest information on the newer insecticides.

BARLEY is the most important cereal crop grown in the desert area. It is grown for grain, pasture and hay. It can be sown in alfalfa fields and used either for a winter pasture crop (when alfalfa is more or less dormant) or harvested early in the spring with the alfalfa as mixed hay. When winter pasturing of barley is intended, it should be seeded between September 20 and October 1.

Barley's greatest importance, however, is as a grain crop.

The chief limiting factor in the production of barley grain from pastured barley is the extremely hot weather, and for this reason pasturing must be discontinued not later than February 1. Late plantings should not be pastured at all. Barley planted for grain between Dec. 1 and Jan. 15 is usually not injured by frost.

Varieties. Since practically all of the barley grown in the region is sold as feed grain, quantity rather than quality is the objective, and the common varieties, California Mariout and Arivat are grown most extensively.

Culture. Drilling the seed is preferable to broadcasting. The use of 60 to 100 pounds of seed per acre is common practice when the barley is planted alone for pasture, hay, or grain. Fifty pounds per acre is sufficient when barley is seeded in alfalfa for pasture.

The seed should be treated to protect against disease and fungi.

Flood irrigation by the strip or border method is used, and an even supply of moisture should be available to the plants at all times during the growing and ripening season.

Fertilization tests have shown a good response to the use of nitrogen on barley—80–120 pounds of nitrogen per acre have given top yields. Normal crop rotations supply sufficient phosphorus for most barley crops.

The yield of grain from commercial fields will probably average 3,000 pounds per acre, though yields of 5,000 pounds are often obtained.

BEANS of various types have been grown in the desert region, and while the commercial possibilities of some have

Barley, particularly California Mariout variety, because of its salt tolerance, is a good initial crop to indicate areas having too much salt, alkali or both. Spots in this stand show concentration areas which cannot produce profitable crops, without leaching.

not been explored, what information is available is given below. Beans are sensitive to salt.

Blackeye beans (*Vigna sinensis*), or cowpeas, are better adapted to the region than any of the other species of commercial beans. When grown under favorable conditions they have made fair yields of good-quality beans.

They may be planted in the early spring, as soon as danger of frost is past. Later planting, about July 1, for a fall crop is preferable, however.

Nematode-resistant varieties are recommended. Blackeye No. 5 is the variety grown for dry beans.

The Horse bean (*Vicia faba*), sometimes known as the broad, or Windsor bean, frequently makes excellent growth when grown during the winter. Horse bean crops are not dependable because the plants are subject to diseases and are very aphid susceptible.

Lima beans (*Phaseolus lunatus*) have never been established as a commercial crop in the region. Present varieties have not given satisfactory yields.

Mat beans (*Phaseolus aconitifolius*), formerly known as moth beans, have been successfully grown, but they have been used only to a very limited extent. There seems to be no established market for the beans.

Mung beans (*Phaseolus aureus*), though susceptible to nematode attack, can be grown successfully in the region. Their culture and soil requirements are much the same as those for Blackeye beans (see above). Mung beans can be grown for seed. Not more than 1,000 pounds of seed per acre can be expected.

Miscellaneous varieties. The Bayo, Pink, Pinto, California Red, and large white beans are not well adapted to commercial production in the desert region.

For a discussion of snap beans, see page 37, under "Vegetable Crops."

BROOMCORN (*Sorghum sorghum var. technicus*), is well adapted to the desert area and has been grown commercially. Black Spanish (tall type) and No. 11 (Dwarf) are the types grown. The Broomcorn is of good quality. Planting is done from March to July, using 36″ rows and 2½ to 4 pounds seed per acre. It is thinned to a stand. A June 1 planting will be ready to cut in about 65 days and a second cutting can be made 55 days later. Broomcorn should only be grown on the best land. Each crop i.e., cutting, is fertilized with 100–150 pounds actual nitrogen per acre. Growers have applied 80–100 pounds per acre of P_2O_5.

Following the first cutting a stalk shredder is run through the field. The new stalks for the second cutting will

When salt, or alkali is excessive it may be removed by ponding and leaching. These fields in the Coachella Valley are being leached between contour borders. Ponded water drives salts and alkali below plant root level.

come up from the base of the original plant.

The large amount of hand labor for harvest, in the hottest part of the summer, makes the cost of growing the crop, high. Yields of 1,000 pounds Broomcorn per cutting i.e., 2,000 pounds per season, are often secured. Costs from planting through delivery to processors in 1955 were about $350–$375 per acre.

BUCKWHEAT (*Fagopyrum esculentum*) has been tried in the desert region and found to be a failure.

CASTOR BEANS (*Ricinus communis*), have been grown commercially for their oil with moderate success. Average yields over the 17,000 acres planted in 1951 were disappointing (about 600 pounds harvested seed per acre). With improved harvesting equipment and varieties, Castor beans might still become an established crop. Shattering and harvesting losses have been the cause of low yields.

Plantings have been made from about March 1 to June 15 on raised beds.

Culture is similar to cotton and other row crops. Castor beans (plants as well as beans) are poisonous to livestock and volunteer plants may become a serious weed pest in following crops.

THE CLOVERS have been little used in the desert region for feed crops, partly because the vast acreage of alfalfa has relieved the demand for other crops of a like nature. Then too, the true clovers do not thrive in the area because of the intense heat. Thus clovers are not all-year crops; they do well only from fall to summer.

Berseem clover (*Trifolium alexandrinum*) grows moderately well when the winters are warm and it grows very vigorously in the spring. It has been only moderately satisfactory because of its susceptibility to injury by frost.

Culture. It can be seeded with barley or oats for pasture, or it can be used for green manure. Seed yields of 500 to 800 pounds per acre have been obtained.

When planted for the first time, the seed must be artificially inoculated with nitrogen-fixing bacteria.

Bitter or Sour clover (*Melilotus indica*) is well adapted to the region and is one of the common winter-growing weeds. It makes vigorous growth during the winters and succeeds on soils of various types. It has a decidedly bitter taste and is not relished by livestock. Bitter clover is annual; *it should not be planted in fields that may later be used for alfalfa seed production.*

Bur clover (*Medicago spp.*) is valuable as a pasture crop and can be used in annual or permanent pasture plantings.

It produces large quantities of seed, but commercial seed production has never been established in the desert region.

Hubam clover (*Melilotus alba*) is adapted to the desert region and is used as an annual pasture plant and for green manure. It should not be planted, however. in fields that will later be used for producing alfalfa seed.

Ladino clover (*Trifolium repens var. latum*) will grow vigorously in the spring and moderately well in the fall. The hot summer weather usually kills off most of the plants during that period.

This crop is not generally grown in the desert region, but when it is planted the seed must be artificially inoculated with nitrogen-fixing bacteria before planting.

Red clover (*Trifolium pratense*) has been found unsatisfactory in the desert region, except as a spring annual. When planted the seed must be inoculated with nitrogen-fixing bacteria.

A PLANTING CHART

for the various field crops listed here appears starting on page 32.

White clover (*Trifolium repens*), also known as White Dutch clover, has the same limitations and requirements in the desert region as those given above for Ladino clover.

White sweet clover (*Melilotus alba*) is a biennial plant. It does not compare favorably with alfalfa or Hubam clover in the desert region, and its planting is not recommended.

CORN of several kinds is now grown to a limited extent in the desert area.

Field corn (*Zea mays*). Some of the newer hybrid varieties of field corn have given reasonably good yields. About 80 bushels of shelled corn or 25 tons of silage per acre have been the highest yields. This crop does not depress yields of following nonleguminous crops as severely as do the grain sorghums. The local Farm Advisor's office is able to supply the names of hybrid varieties best adapted to any locality.

Culture. Corn should be planted as soon as danger of frost is over (about February 15), to avoid its tasseling during the extreme summer heat, which will seriously interfere with pollination. Summer plantings for late fall harvest are not recommended because of excessive worm infestations.

Use only good land for growing corn. Nitrogen in large amounts (150–200 lbs. N per acre) is needed to produce high yields of dry corn or silage. Nitrogen should be applied during early growth of the plants.

The beet army-worm and the corn earworm are serious pests, particularly on summer plantings.

Popcorn (*Zea mays var. everta*) should be planted in the early spring (March) so that extreme heat may be avoided during the pollinating period. Summer plantings (July 15–Aug. 1) will grow satisfactorily but are usually severely damaged by corn earworms.

Like other crops, popcorn should be grown on well-prepared, fertile soil and given plenty of moisture. The damage done by corn earworms is often serious.

COTTON (*Gossypium spp.*) is well adapted to the desert areas. Both long staple, Egyptian, and short staple, Acala, varieties are grown. By far the biggest acreage is devoted to the short staple variety.

Culture. Cotton will grow and produce a profitable crop over a wide range of soil conditions. It grows best on sandy loam to clay loam soils, but has been grown extensively on the sandier soils. Although it may not do as well on saline, alkaline, or heavy clay soils, cotton may still do better than many other crops grown under the same conditions.

Plantings are made any time after the soil warms in the spring, usually around April 1–10. Plantings can be made as late as June but these usually produce lower yields. Seed is drilled into moist ground on raised beds using 15 to 25 pounds of seed per acre. If the soil is wet to a good depth at the time of planting and a satisfactory plant emergence is obtained, the new planting is not irrigated for a considerable time. This discourages weed growth. An appreciable acreage, however, is planted into slanted dry beds and irrigated up. This increases weed problems but may result in better initial stand of cotton, particularly on clay and saline soils.

Do not allow the plants to wilt at any time. A constant, uniform supply of moisture should be available to the roots until the crop is nearly mature, usually into October.

Insect control is essential whenever an infestation of pests builds up to damaging levels. *Preventative treatments are not advisable.*

Fertilizer, especially nitrogen, is used in large amounts. Phosphate, if used, is applied at or ahead of planting 40 to 80 pounds of actual phosphate, P_2O_5, per acre. One hundred and twenty to 200 or more pounds of actual nitrogen per acre is applied in one or more applications, early in the season when plants are small.

Harvest. About half the cotton produced in the desert area is picked by machine pickers. A common practice is to pick the bottom crop by hand in September and the remainder by machine in December.

COWPEAS (*Vigna sinensis*). See Blackeye beans, page 21.

CROTALARIA varieties are not well adapted to the desert area. Other green manure crops are much better adapted and the planting of crotalaria is not recommended.

FLAX (*Linum usitatissimum*). Flax growing in the desert area has developed rapidly since the early 30's and is now one of the principal crops in Imperial Valley. More flax is produced in the area than in any other region of similar size in the United States.

Beware of Weeds. Flax does not compete with weeds. Crop rotation is the best weed control. If necessary, most weeds can be controlled with chemicals but it may be quite expensive.

Planting. Use great care in preparing the seedbed for flax. Most flax is drilled in 6-inch rows. Drill rows are made parallel to or across borders. Drill the seed into moist ground so that it will sprout quickly. Very little of the flax acreage is irrigated up.

Irrigation. The moisture condition in the root zone should determine the number of irrigations given to flax—most growers apply 5–7 irrigations during the growing season.

Insufficient moisture during the growing season, or irrigation stopped too far ahead of harvest have caused many low yields.

Fertilization. Flax responds to both nitrogen and phosphorus. Common practice is to apply 80–120 pounds of P_2O_5 and 80–160 pounds of nitrogen per acre. Past experience indicates that flax may respond to residual fertilization from previous heavily fertilized crops. This factor may be important in deciding specific fertilization needs for flax fields.

Flax is highly susceptible to wilt and "curly top" virus. A wilt resistant variety

Farming in the desert region is highly mechanized. In this field alfalfa was tractor mowed, side delivery raked, pickup baled, and is being mechanically bale loaded onto trucks for stacking.

has been developed but there is no virus resistant variety yet.

GARBANZOS (*Cicer arietinum*) can be grown in the desert area but they have not been produced commercially because the market apparently is limited.

Culture. When planted from October 15 to November 15, the beans can be harvested in April or May. The culture is about the same as for garden peas (see page 27).

Garbanzos must be artificially inoculated with special nitrogen-fixing bacteria when planted for the first time. Experimental plantings have yielded 1,500 to 2,000 pounds of beans per acre.

GRASSES. Permanent pasture mixtures of grasses and legumes containing up to 18 different varieties have been tried extensively in the desert area. Farmers quickly dropped most of these varieties and for the most part grew a mixture of alfalfa and Alta fescue with a few also using Dallis grass. After a few years most farmers decided against a mixture. Alfalfa alone or Alta fescue alone was used. Because of nutritional deficiencies and poison dangers most desert farmers have abandoned permanent pasture programs in favor of a farming program using alfalfa and annual forage crops separately.

The land remaining in grass alone is for the most part marginal and seeded to bermuda.

Alta fescue (*Festuca arundinacea*) is well adapted to the area. Growers have planted it as the sole grass in permanent, irrigated pastures, and seed crops in the area have yielded 200 to 250 pounds per acre.

This variety produces well throughout the year, even though it does decrease during the winter months. It is relished by livestock, is drought tolerant, and reasonably alkali tolerant. Alta fescue, pastured alone has resulted in serious nutritional deficiency causing lameness and in extreme cases, loss of hoof. Alta fescue should be drilled, but may be broadcast in an alfalfa-type seedbed. Liberal applications of nitrogenous fertilizer will increase the forage yield.

Bermudagrass (*Cynodon dactylon*) is one of the most important grasses in the area, succeeding on land that is too heavy and too alkaline for alfalfa. While it is a pest in cultivated fields, it is an excellent pasture crop (under good care, it has a surprisingly high carrying capacity) and it is valuable as a lawn grass because it remains green all summer with ordinary care.

Excellent seed crops of Bermudagrass can be produced; yields of 500–1,000 pounds per acre or more are possible.

When the crop is grown for seed the field is usually pastured from September to May, then the stock are removed and the field is thoroughly irrigated. The seed crop can be harvested late in August.

Coastal Bermuda is being tried experimentally but it must be transplanted to the field as it does not produce seed.

Dallisgrass (*Paspalum dilatatum*) grows well from May through September but frosts down during the winter, like Bermuda or Rhodesgrass. It is a very vigorous grower, and after a few years will form large clumps which are not killed by frost. It is not crowded out by Bermudagrass in the area.

The young growth is relished by livestock but the seedheads and stalks are not readily eaten, so Dallisgrass pastures should be mowed occasionally. Mature Dallisgrass heads infected with ergot have been diagnosed by plant pathologists as the poison causing death, in one instance. Young stands of fall-seeded Dallisgrass may be killed by winter frosts.

It will produce from 200 to 300 pounds of seed per acre but seed production is hazardous since ergot may destroy the seed.

Perennial Ryegrass (*Lolium perenne*) does well in the desert area only during the winter and spring months.

Annual Ryegrass (*Lolium multiflorum*) does well only during the cool weather. It is not recommended for general planting, but may be seeded in perennial pasture (after an early fall renovating) at a rate of about 10–15 pounds of seed per acre.

Annual Ryegrass is extensively used as a lawn grass, but needs liberal applications of nitrogenous fertilizers.

Johnsongrass (*Sorghum halepense*) is classified as a pest—**planting of this grass is prohibited by law** and its introduction into fields should be carefully guarded against. This grass propagates either by seed or root stolons. It is a very serious weed pest when once established. It is perennial in growth habit and resembles Sudangrass in several respects. *Chemical control is possible—see your farm advisor.*

Rhodesgrass (*Chloris gayana*) is not recommended in the desert area.

It is a perennial, propagates by seed and by layering of its spreading branches, and it produces fairly well. However, it accumulates considerable salt when grown on saline soils and becomes unpalatable to livestock.

Sudangrass (*Sorghum vulgare*) is well adapted to the desert area and is popular as a summer pasture crop. By subdividing the field, and using alternate grazing and resting periods, Sudangrass may be pastured continuously until late fall. When grown on productive soils and under good care, it gives excellent yields.

Culture. Sudangrass is adapted to a wide range of soils, but good seedbed preparation is necessary. It can be drilled or broadcast from April 1 to August 1. Under normal climatic conditions it will be ready to pasture within 6 weeks after the time of planting.

Danger. Keep Sudangrass growing vigorously. If the plants become stunted from lack of moisture, or from frost, Sudangrass may be dangerous to livestock because of prussic acid poisoning.

Guar (*Cyamopsis tetragonoloba*) is an annual legume and may be grown as a green manure crop, or for seed production. The yield of green tops per acre varies from 12 to 19 tons. The plant is resistant to nematodes and produces an abundance of seed.

Seeds of Guar are hard and do not germinate readily so the soil should be thoroughly warm and moist at planting time. The use of scarified seed might increase the percentage of germination.

For a maximum yield, a growing season of 90 to 120 days should be allowed.

JERUSALEM ARTICHOKES (*Helianthus tuberosus*) grow well on light and medium-textured soils and yields of 3 to 4 tons of tubers per acre can be obtained. When planted in April or May, the tubers will mature in November.

This crop is used mainly as stock feed, but because other crops produce more feed, or are easier to handle, Jerusalem artichokes are not grown commercially.

KUDZU (*Pueraria thunbergiana*) has been tried several times in the desert region, but without much success. It is not recommended for commercial planting.

LESPEDEZA (*Lespedeza stipulacea*) or Korean lespedeza, as it is usually called, will grow but is not well adapted to the desert area.

MILLET (*Setaria italica*) includes the group of so-called foxtail millets, most varieties of which have given only fair results in trial plantings.

Summer plantings usually do better than spring plantings, and hog millet (Proso) is the most satisfactory of the group. A few fields of Starr millet have been grown. All of the millets are annuals.

OATS (*Avena sativa*) are becoming more popular with the introduction of the new shatter-resistant Indio and Palestine varieties. Grain yields of two tons and over have been reported. These are much shorter stemmed varieties than the regular Kanota, more commonly used for hay.

PEANUTS (*Arachis hypogala*) are adapted to the sandy and sandy loam soils of the desert areas. In the late 1940's, 500 acres planted in the Coachella Valley yielded 200–300 pounds per acre, which was unsatisfactory. Experimental plantings have produced a ton of peanuts per acre. Planting should be done after danger of frost is past and prior to June 1. The Spanish variety should be planted in rows three feet apart and about 8–12 inches apart in the rows. All peanut seed must be inoculated with nitrogen nodule forming bacteria. However, the peanut is difficult to inoculate artificially in the Coachella Valley, although artificially inoculated, most peanut plants were yellow and unthrifty and had no nitrogen nodules on their roots.

PEAS (*Pisum arvense*) have not been grown extensively in this area, but such varieties as the Canadian Yellow, Blue Prussian, Canada White, and others, grow reasonably well. Papago peas have been successfully grown at Yuma as a green manure crop. Other soil-building crops, however, are liked better by the growers.

Plantings made in October can be turned under in January or early February. Field peas are attacked by aphids and mildew.

RAMIE (*Boehmeria nivea*) is an excellent fiber plant and is well adapted to the desert conditions. It is a perennial crop.

Since an economic method of separating the fibers has not been developed, there has been no commercial production of Ramie.

RICE (*Oryza sativa*) can be grown reasonably successfully in the desert area if due attention is given to details during critical periods. In fact, rice is grown on saline lands as part of the reclamation process—the growing of rice will help to reclaim the land. On lands so badly impregnated with salts that they had to be abandoned, the growing of one crop of rice leached out so much of the salt that good crops of milo (showing no alkali injury) were later produced.

Adequate drainage must be provided before rice is grown, or surrounding lands may be severely injured.

The greatest obstacle to the growing of rice is the excessive sun-checking of the grain.

The land must be carefully leveled and checked so that a uniform depth of water from 6 to 10 inches can be maintained.

Flood the checks to a depth of 4 to 6 inches, and seed the rice in the water. This depth of water is maintained until the rice is established, then gradually increased to 8 inches or more as the plants grow. A maximum depth of 4″ to 6″ is maintained from the time the rice begins to head until the kernels are filled out and begin to harden.

The water should then be removed, so that the ground will be dry enough to support harvesting machinery by the time the rice is mature.

Rice should be seeded in May or June, so that maturity will be delayed until after the period of highest temperature. A seeding rate of 125–150 pounds per acre should give a stand thick enough to insure even ripening.

The common varieties are Edith, Blue Rose, and Zenith.

RYE (*Secale cereale*) is not well adapted to the desert region as a grain crop.

SAFFLOWER (*Carthamus tinctorius*). Safflower seed, which looks something like sunflower seed, is used for oil production. After the oil is extracted, the residue can be used for cattle feed.

The plant grows about 3 feet high, has a hard, pithy, stiff stem, and most varieties have sharp spines on the edges of the leaves and on the heads. Some new varieties without spines have been developed.

Safflower has developed root rot when irrigated in the desert area and is not recommended. New varieties may overcome these difficulties.

Grain sorghums are a warm season crop—grown after winter vegetables or cereals—yields of 4000–5000 pounds per acre are not uncommon. "One man" harvested, the grain will be marketed at the terminal markets or cattle feedyards.

SESAME (*Sesamum orientale*) grows well in the desert region, but may not become profitable until new non-shattering varieties are developed. Seed pods of the present varieties split and scatter seeds on reaching maturity, and harvesting the crop is very difficult.

SESBANIA (*Sesbania macrocarpa*) is one of the most rapid-growing and popular summer legume green manure crops grown in the desert region. It can become a weed.

Sesbania thrives only in the summer heat and, at this time of year, if plenty of moisture is available, will grow to a height of 8 to 12 feet in 60 days.

Culture. There is little difference, if any, in yield obtained from seeding rates of 20 or 40 pounds per acre. The main advantage of the higher rate is that the plants will be smaller, easier to turn under, and will decompose more readily.

Sesbania is usually broadcast, then harrowed and irrigated by the strip or border method.

Irrigations should be frequent to force rapid growth, but no other attention is needed until the first seed pods form, at which time the crop should be turned under.

Nematodes will attack sesbania, and this crop should not be grown on sandy soils in rotation with other susceptible crops such as melons, tomatoes and cucumbers.

Sesbania is also a host for the alfalfa caterpillar. When attacked by this pest the entire crop should be turned under immediately, before the caterpillars mature, destroy the cover crop, and then spread to any nearby alfalfa fields.

Volunteer sesbania plants are a weed in crops of cotton, milo, etc.

SORGHUMS (*Sorghum vulgare*) are well adapted to the prevailing climate of the desert region. They are suited to a variety of soil types.

Grain sorghums are very important in the region from a standpoint of acreage planted. Many red and yellow seeded varieties of the grain sorphums, such as Double Dwarf 38, Ryer 15, Martin Combine, Double Dwarf Yellow Sooner, are subject to "seed set failure", i.e., fail to set a commercial crop of seed when planted after June 1.

White seeded varieties such as Hegari, Imperial Kafir, etc. have not been affected by seed set failure. Nitrogen, at the rate of 120 lbs. of actual nitrogen per acre, applied at time of planting or very early in the growth of the sorghum, is a common practice. The grain sorghums are irrigated frequently and must have plenty of moisture, especially from the time the head first appears until the seed is filled.

Double Dwarf Milo '38 formerly was planted on a major part of the grain sorghum acreage. The plants are dwarf in growing habit (2 to 4 feet high on the average) and uniform in height, therefore well adapted to machine harvesting. Plantings made before June 1 are giving normal yields.

Ryer 15 is a yellow seeded milo and was selected from a field of Double Dwarf '38. It is planted in close spacing using grain drills (12" or 14") and 30–50 pounds of seed per acre are used. It does not "tiller" (stool) like other grain sorghums. The heads stand 12" or more above the leaves so it can be threshed while the stalks and leaves are green.

Plantings are made in April and May —harvested in August. It is subject to seed set failure if planted after June 1.

Martin Combine has also been grown in the desert area; it is dwarf in growth habit and has large, erect heads.

Hegari has been grown in the area for some time and is a favorite for silage. This, too, is a dwarf variety, producing white grain splotched with pink or brown. The plants are more leafy, the heads more erect, and the foliage more succulent than milos. For this reason Hegari stalks make better pasture after the grain has been harvested, and better silage. Hegari, sown broadcast, has been used successfully as hog pasture.

Kafirs produce fairly well but require a longer growing season than most other grain sorghums, so are not popular.

The Kafirs tiller or stool (i.e., form bunches) very little, so require closer spacing in the rows than do many milos.

Imperial Kafir, a white seeded variety, is not affected with seed set failure. It yields well for grain, makes good silage, and appears to have considerable resistance to bird damage. It has been most successful when planted on beds because seedlings are weak.

Sorghum for silage. Sorghum silage is a very popular cattle feed in the desert area. Hegari is now most commonly used. Rex sorgo shows promise as does Imperial Kafir. Two crops for silage can be made from one planting when the sorghum is planted early. Best yields are secured when nitrogen fertilizer is applied for each harvest.

Atlas sorgo stands up fairly well, and over a ten year period, averaged 27 tons per acre on test plots.

Honey sorghum, Red Amber, and many others yield well, but frequently lodge (fall over) making machine harvest very difficult.

Rex Sorgo is a high yielding sweet sorghum that offers promise for silage. It can be planted early (late February) and two harvests for silage can be made from this one planting. It does not "lodge" (fall over) as much as most other sweet sorghums. It produces very little grain.

Other varieties. Practically all of the grain sorghums will grow well in the desert area, but for various reasons none but those mentioned above have become popular. Others that will grow

well include Durras, Feterita, Heilman milo, Shallu, Manko, and Ajax.

Sorghum culture. Sorghums may be planted any time after the soil becomes warm in the spring. Before seed set failure appeared, tests showed that late plantings (June 1 to July 1) resulted generally in higher yields. Late plantings (i.e., after August) are apt to be damaged by early frost. Any of the sorghum varieties planted before June 1 have been producing good yields. After June 1, Hegari and Imperial Kafir are best because they have not been affected by "seed set failure."

Seeding flat on preirrigated land is the common practice, and is successful if ample moisture is present to germinate the seed without the necessity of another irrigation soon after planting. Imperial Kafir is generally planted on beds because the seedlings are weak. From 4 to 10 pounds of seed per acre (except Ryer) should result in a good stand.

Warning. *The sorghums (including Sudangrass) will cause a temporary reduction in the available nitrogen content of the soil for crops such as barley, wheat or oats, following in rotation.* Thus a sorghum crop should be followed by a legume which will produce its own nitrogen. If followed by a nonlegume the land must be heavily fertilized with nitrogen.

SOYBEANS (*Soja max*) of a shatter resistant variety, Lee, have been recently introduced as a summer crop and fit well into a double crop system. Salt tolerance is low so the crop should be planted on land below 5 millimhos in salt content (see table page 10).

Best results to date have been from planting on raised beds. Plant in moist ground or irrigate up. For best yields, inoculation of seed is essential, but difficult to accomplish.

Harvest by direct combine as soon as the seed moisture content is below 15 per cent. Soybean seed is easily damaged in harvesting if too dry. Slower cylinder speeds are used on combine than for cereal grains.

SUGAR BEETS (*Beta vulgaris*) have become one of the important crops in the Imperial Valley. They produce good yields in both tonnage and sugar content; fit well into the rotation program of the field crop or vegetable grower by providing a good cash crop; they can be grown successfully for at least 2 years on the same land.

Culture. Sugar beets are best grown on good land, carefully farmed.

The land is commonly fertilized with about 80 pounds of P_2O_5 and up to 160 pounds or more of nitrogen per acre. The phosphate should be applied before planting with about $\frac{1}{3}$ of the nitrogen. The rest of the nitrogen can be added as a side dressing in 1 or 2 applications.

Late September, early October are the best times to plant. The beets may then be harvested from May to July.

Usually 4 to 6 pounds of seed per acre is used. Beets are thinned by hand to one plant every 5 inches on 30 inch single-row beds, or 8 inches on 42-inch double-row beds.

Harvesting is done entirely by machine and a single large machine can harvest from 150 to 200 tons a day.

Curly top resistant varieties are used. Pests attacking sugar beets are numerous. Crickets, grasshoppers, darkling ground beetles, sugar beet army worms, cutworms, aphids and others frequently give trouble. The local farm advisor should be consulted on insect control programs.

Yield. Sugar beets will average from 18 to 22 tons per acre with a 16 to 17 per cent sugar content. Higher and lower yields may be obtained, depending on the soil and farming methods employed.

SUNFLOWERS (*Helianthus annuus*), while growing well in the desert region, have never become popular as a commercial crop because they produce less

grain than the grain sorghums, and they are more expensive to harvest.

Culture of sunflowers is very much the same as that recommended for sorghums (see page 30).

VETCHES (*Vicia spp.*) are valuable as forage and as green manure crops, but the seed must be inoculated with the proper nodule-forming bacteria, and then handled correctly, or failure is likely to ensue.

Vetches are subject to damage by aphids and mildew, but planting in September or early October will lessen the danger from these troubles.

Purple vetch (*Vicia atropurpurea*) grows well during the fall, winter, and spring, and is used as a green manure crop and for pasture. It is usually seeded with barley or oats when used for pasture.

When planted at the rate of 40 pounds of vetch seed and 25 pounds of oats or barley seed per acre, from September 20 to October 1, the crop will provide winter pasture starting in early December. Oats planted with vetch makes excellent hay, but since oats make better spring growth than barley, oats and vetch should be used for December and January plantings for pasture.

Common vetch (*Vicia sativa*) seed is usually cheaper than purple vetch. It does as well as purple vetch when planted after January 1, but plantings made at this time are more susceptible to damage from mildew and aphids.

WHEAT (*Triticum vulgare*) is well adapted but is not as popular in the desert region as is barley.

Culture of wheat is the same as for barley. Ramona '50 and White Federation '54 are the best varieties for the area.

Fertilization tests have shown responses to nitrogen and occasionally to phosphorus.

CAUTION

The enactment of recent legislation dealing with residues of agricultural pesticides allowable with raw agricultural products makes it necessary for growers to apply only chemicals for which established tolerances have been set.

For this reason, check with your local agricultural authorities to see that your insect-control program does not constitute a violation of the present law. For certain hazardous materials, at certain levels, it is necessary to post fields with "poison out" signs and obtain permits to conform to state and local laws.

Planting Calendar for Field Crops

Crop	Adaptability	Quality or use	Variety recommended	Best time to plant	Pounds seed per acre	Distance apart of rows	Spacing of plants in row	Date mature for harvest	Average yield per acre
Alfalfa (1)	Excel.	Excel.	Africa	Oct. 1–Nov. 15	20–30	Drilled or broadcast		Mar. 1–Nov. 25	6 tons hay and winter pasture; 300–400 lbs. seed
Barley (grain and hay)	Excel.	Excel.	Calif. Mariout Arivat	Dec. 1–Jan. 15	60–100	Drilled or broadcast		Apr. 15–May 15 (grain)	3000–5000 lbs. grain or 3 tons hay
Barley (Pasture)	Excel.	Excel.	Calif. Mariout Arivat	Sept. 20–Nov. 15	50 (in old alfalfa) 60–100 (alone)	Drilled		Pasture to Feb. 1	90 days pasture
Beans:									
Blackeye (2)	Fair	Good	Blackeye No. 5	July 1–15	20–30	32–36″	6″	Oct.–Nov.	1000 lbs. beans
Horse (2)	Fair	Good		Oct. 1–30	150	6″	6″	Feb. 1–Mar. 1	12 tons green
					50	32–36″	6″	Feb. 1–Mar. 1	12 tons green
Mat (2)	Poor	Good	Buff	Apr. 1–July 1	6–8	32–36″	6″	Aug. 1–Nov. 15	15 tons green
Mung (2)	Fair	Excel.	Kearney	Apr. 1–July 1	6–8	32–36″	4″	Aug. 1–Nov. 15	7 tons green, 1½ tons hay, 800 lbs. beans
Tepary (2)	Fair	Good	Com'l var.	Aug. 1–Aug. 30	35	32–36″	6″	November	.....
Velvet (2)	Fair	Good	Bush	Mar. 1–Apr. 30	35	32–36″	12″	Sept. 1–Nov. 15	12 tons green
Beets:									
(stock)	Good	Good	Half Sugar Golden Tankard	Sept. 20–Nov. 1	10	30″	12″	Mar. 1–July 1	20 tons
(sugar)	Excel.	Excel.	Com'l var.	Sept. 1–Nov. 1	4–6	42″ double 30″ single	5–8″	May–July	20 tons
Broomcorn	Good	Good	Dwarf No. 11 Black Spanish	Apr.–July	3½–4	36″	6–15″	Aug. (early) Oct. (late)	1000–2000 lbs. brush
Castor Beans	Good	Excel.	Com'l var.	Apr.–June 15	12	42″	6–12″	Oct.–Nov.	1500–2500 lbs.
Clovers:									
Berseem (1)	Good	Excel.	Miswaki, Saidi	Oct. 1–Oct. 15	15–20	Drilled or broadcast		Jan. 1–May 1	Pasture, or 3 tons hay
Bitter or Sour (1)	Excel.	Poor	Com'l seed	Sept. 20–Dec. 15	20	Drilled or broadcast		Cover crop, Jan. 1–Apr. 15	10–12 tons (green)

Bur (1)	Good	Excel.	Com'l seed	Sept. 20–Dec. 15	20	Drilled or broadcast		Pasture, Nov. 20 to spring	6–8 tons green
Ladino (1)	Poor	Excel.	Com'l seed	Oct. 1–Nov. 15	6–8	Drilled or broadcast		Pasture all year	.....
Sweet (annual) (1)	Excel.	Good	Hubam	Oct. 1–Nov. 30 Mar. 15–Apr. 30	15–20	Drilled or broadcast		May 1–July 1 Sept. 1–Oct. 1	Cover crop, 8–15 tons; seed, 800–1000 lbs.
White Dutch (1)	Poor	Excel.	Com'l seed	Oct. 1–Nov. 15	6–8	Drilled or broadcast		Pasture or lawn all year	
White or Yellow (Sweet) (1) (biennial)	Fair	Good	Com'l seed	Oct. 1–Nov. 1 Feb. 1–Apr. 1	15–30	Drilled or broadcast		Pasture or hay, 6 months after planting	
Corn (field)	Good	Excel.	Adapted hybrids and Mexican June	Feb. 15–Mar. 1	10	36–42″	8–12″	July 1–Aug. 1	3000–4000 lbs. grain 15–25 tons silage
Corn (pop)	Fair	Fair	Pearl or Rice	July 15–Aug. 1	5–6	36″	12″	Oct. 15–Dec. 15	500–700 lbs. grain
Cotton:									
(upland)	Excel.	Excel.	Acala	Mar. 15–June 1	15–25	38–42″	2–12″	Aug. 1–Jan. 1	2 bales
(long-staple)	Excel.	Excel.	Pima	Mar. 15–May 15	15–25	38″–42	2–12″	Aug. 1–Jan. 1	¾ bale to 1 bale
Cowpeas (2)	Fair	Good	Iron; Brabham; Victor	Apr. 15–July 15	12 (rows) 36 (drilled)	36″	6″	Aug. 15–Nov. 15	15 tons green
Fenugreek (2)	Fair	Fair	Com'l var.	Sept. 15–Oct. 20	40	Drilled or broadcast		Jan. 20–Feb. 25	10 tons green
Flax	Excel.	Excel.	Imperial and Punjab selections	Dec. 1–Jan. 15	40–60	Drilled		May 15–July 15	2000 lbs.
Garbanzo (1)	Fair	Good	Com'l var.	Oct. 1–Oct. 30	12–20	36″	6″	Apr. 1–May 30	1500–2000 lbs. beans
Grasses:									
Alta Fescue	Excel.	Good	Com'l seed	Oct. 1–Dec. 15	20	Drilled or broadcast		Pasture	Pasture; 200 lbs. seed
Bermuda	Excel.	Good	Com'l seed	Mar. 15–Apr. 15	5	Broadcast		Pasture, spring–fall	Pasture; 200 lbs. seed
Dallis	Excel.	Fair	Com'l seed	Mar. 15–Apr. 15	10	Broadcast		Summer	Pasture; 250 lbs. seed
Elephant	Fair	Poor	Napier	Mar. or Apr.	3630 plants	48″	36″	Pasture, spring–fall	Pasture
Para	Good	Poor	Para	Mar. or Apr.	10,890 plants	24″	24″	Pasture, spring–fall	Pasture

(1)—Inoculate with nitrogen nodule-forming bacteria when planted on new soil or following leaching.
(2)—Inoculate with nitrogen nodule-forming bacteria every year.

Planting Calendar for Field Crops—(Continued)

Crop	Adapt-ability	Quality or use	Variety recommended	Best time to plant	Pounds seed per acre	Distance apart of rows	Spacing of plants in row	Date mature for harvest	Average yield per acre
Grasses (cont'd)									
Rhodes	Excel.	Poor	Com'l seed	Mar.–May	5	Broadcast		Pasture, spring–fall	Pasture
Rye—Perennial or Annual	Excel.	Excel.	Com'l seed	Oct. 1–Dec. 15	15	Broadcast		Pasture, spring	Pasture
Sudan	Excel.	Excel.	Tift or Sudan '23	Mar. 15–Apr. 15	20–30	Drilled or broadcast		Pasture, May 1 to frost	4–6 tons hay
Millet	Good	Excel.	Proso; Starr	Apr.–Sept.	20	Drilled or broadcast		75–90 days from plnt.	1 ton seed
Mustard	Good	Fair	Trieste; White	Oct. 15–Nov. 20	10	Broadcast		Jan 1.–Mar. 30	10–12 tons green
Oats	Excel.	Excel.	Indio; Palestine Kanota	Nov. 1–Jan. 1	75–90	Drilled or broadcast		Apr. 15–May 15	2000–3000 lbs. grain; or pasture; 3–4 tons hay
Peanuts (2)	Fair	Good	Spanish or Virginia	Apr. 15–June 1	20–35	36″	8–12″	Oct. 15–Nov. 30	Not established
Peas (field) (2)	Fair	Good	Papago; Canadian Yellow; Prussian Blue	Sept. 20–Nov. 1	75–100	Drilled or broadcast		Jan 20–Mar. 1	6–8 tons green
Ramie	Good	.....	Com'l var.	Jan. 1–Mar. 1	10,890 roots	48″	12″	Spring to fall	6 tons dry stalks (15% fiber)
Rape	Poor	Poor	Dwarf Essex	Sept. 20–Oct. 30	8	Drilled or broadcast		Dec. 1–Apr. 1	Pasture
Rice	Good	Fair	Blue Rose; Edith; Zenith	May 15–June 30	125–150	Broadcast		Sept. 15–Nov. 10	2000 lbs.
Sesbania	Excel.	Excel.	Common macrocarpa	May 15–Aug. 1	20–50	Drilled or broadcast		July 15–Oct. 1	10 tons green 1000 lbs. seed
Sorghum (grain)	Excel.	Excel.	DD 38, Ryer 15 Martin Yellow Sooner	April–May	4–10 40 (Ryer)	32–42″ 12 (Ryer)	2–6″	Aug.–Sept.	2000–4000 lbs. grain

	Excel.	Excel.	Hegari; Imperial Kafir	April–July	4–10	32–42″	2–6″	Sept.–Dec.	2000–3000 lbs. grain
Sorghum (silage)	Excel.	Excel.	Hegari	April–July	4–10	36–42″	2–6″	Aug.–Nov.	20–30 tons green
			Atlas	April–July	4–10	36–42″	2–6″	Aug.–Nov.	20–30 tons green
			Rex Sorgo	Feb. 15–July	4–10	36–42″	2–6″	July–Nov.	20–30 tons green
Soybeans (2)	Good	Good	Lee	May 15–June 15	30–60	36–42″	2–6″	November	1500–2000 lbs.
Sunflowers	Good	Good	Mammoth Russian	July 1–July 30	5–10	36″	12″	Nov. 1–30	15 tons ensilage; or 1000–1500 lbs. grain
Vetch (2)	Excel.	Excel.	Purple	Sept. 20–Nov. 1	50	Drilled or broadcast		Apr. 1–May 1	12 tons green; 2–3 tons hay
	Good	Excel.	Common	Nov. 1–Jan. 1	60	Drilled or broadcast		Apr. 1–May 1	12 tons green; 2–3 tons hay
Wheat	Good	Excel.	Ramona '50	Nov. 15–Jan. 15	60–80	Drilled		Apr. 1–May 30	1500–3000 lbs. grain
	Good	Excel.	White Fed. '54	Nov. 15–Jan. 15	60–80	Drilled		June 1	1500–3000 lbs. grain

(1)—Inoculate with nitrogen nodule-forming bacteria when planted on new soil or following leaching.
(2)—Inoculate with nitrogen nodule-forming bacteria every year.

VEGETABLE CROPS

Sunny days, the mild temperature, and the abundance of irrigation water in the desert region have made the Imperial, Coachella, Palo Verde and Bard valleys famous for the production of winter vegetables for shipment to less favored regions. Even in the coolest weather a great number of vegetable crops can be grown in the open fields without protection.

Some of the winter or early spring plantings are protected by glazed transparent "hot caps" or by south-slanted shelters of kraft paper, supported by arrow weed or lath, built along the rows, leaving the south side exposed. Later, when danger of frost and wind damage has passed, the covers are removed.

Early maturity is the goal to be sought with nearly all of the commercial vegetable crops and all cultural practices are based on this.

Soils. Well-drained, sandy soils in warm locations produce the earliest crops. Medium-textured soils generally give good yields of high quality. The clay soils are the least suitable for most vegetable crops.

Soil conditioning. The use of alfalfa in rotation with vegetable crops has been a common practice for many years as has been the liberal application of poultry or barnyard manure. The practice of growing and turning under of summer cover crops has been followed for many years.

When cover crops are grown, they should be turned under in time to be completely decomposed before a vegetable crop is planted on the same land. About 60 days will be required for this, as a rule.

Many vegetable crops are grown with only commercial fertilizer, but animal manures can be used when cost allows.

Irrigation of practically all vegetable crops is by the furrow method. Most vegetable crops are shallow-rooted and require lighter but more frequent irrigations than the perennial field, tree or vine crops.

Pests that may injure vegetable crops are numerous and must be constantly guarded against. Rotation with alfalfa or other field crops, or even with other vegetable crops, is desirable to reduce

pests and disease. *The local office of the Agricultural Extension Service has the latest information on disease and pest control.*

ARTICHOKES (*Cynara scolymus*). The globe artichoke is a hardy perennial and produces very well in the desert region, but the heads are usually of poor quality. Commercial planting is not recommended.

ASPARAGUS (*Asparagus officinalis*) is well adapted to the desert region but requires great skill to grow. It is a perennial and plantings last six years or more.

Soil. Asparagus grows and produces best on the sandy loam and loam soils—sand gets into the spears on more sandy lands.

Planting. Most asparagus now is seeded in the field rather than transplanted. A double row of asparagus seed is planted one inch, or slightly more, below the soil surface on each side of a furrow (about five inches below the original soil surface before furrowing). The two rows are about 12 inches apart. The furrows, center to center, are about five feet apart. This method takes about five pounds of seed per acre. Plantings with one row in the bottom of a furrow take about three pounds of seed per acre. Single row plantings in this area vary in width from 36 to 60 inches. The seed is irrigated up. The common planting date is in March. A small cutting is made the second year and a full cutting the third year after planting.

Varieties. A number of new varieties are coming out so the *farm advisor* should be consulted. Mary Washington 500 is currently being used.

Fertilization. Large quantities of animal manure are often applied to supply the nitrogen needed for growing asparagus. One hundred pounds or more of actual nitrogen per acre is needed on this crop.

Weed control. Bermudagrass and weeds must be controlled in asparagus fields—Bermudagrass in the fields has caused crop failures. Frequent and thorough cultivations are necessary, together with considerable hand work with hoe and shovel, to keep out weeds. Chemicals are showing great promise in controlling weeds in asparagus plantings.

Cutting begins the first of February and usually lasts from 6–8 weeks. When asparagus comes into the market from other areas harvest usually stops in this area.

After harvest has been discontinued, the asparagus should be allowed to grow large tops and mature. Irrigation should be continued to enable the plants to develop the large tops they require. The mature tops are disked in December, and the plants irrigated soon afterward, to start new growth for the next season.

When fall harvesting is practiced, the tops are cut or disked in late September and the plants irrigated immediately afterward.

BEANS (*Phaseolus spp.*). For commercial dry beans see page 20 under Field Crops.

Both pole and bush type green beans are well adapted on soils of low salt content in the Coachella Valley. Salinity is a limiting factor in many areas.

Best yields are obtained from spring plantings. If planted in the spring, beans should be grown only in the more sheltered warm sections. Early spring plantings will require from 90 to 100 days for maturity. Fall plantings usually mature in 60–75 days. Bush types will come into bearing from 10–20 days ahead of pole types.

Beans do best in a medium loam soil, with good drainage. Use good seed treated to prevent rotting or damping-off. Growers are planting 80–100 pounds per acre of the bush bean varieties. Wade and Black Valentine are the most popular. Liberal amounts of nitrogen fertilizer should be added. A common practice is to use both manures and commercial fertilizer.

An early cantaloupe field with the young plants capped to protect them from possible frosts. Workers are lifting the caps, thinning the new plants and removing the weeds. Later the caps will be removed. The beds slope to the south to trap heat.

Pole types should be supported by wires, string, or poles. Bean stringing machines have recently been developed and are being successfully used in the Coachella Valley.

Beans are very, very sensitive to salinity. A soil test can determine whether the soil is too salty.

Beans are very susceptible to nematodes, and should only be planted on soil that is known to be free of the pest, or that has been fumigated.

BEETS (*Beta vulgaris*). Table beets are not now an important commercial crop but grow well in the area. When grown in the home garden they should be planted in the fall and grown as a winter crop because they are very sensitive to heat.

For discussion of sugar beets, see page 30.

BROCCOLI (*Brassica oleracea var. italica*) is well adapted to the desert region. The early Italian Green Sprouting is the variety commonly grown.

Culture. The growth of this plant must be continuous and rapid, to produce high quality heads. It grows best on heavy soil with a high water-holding capacity. Lighter soils, if used, must be heavily fertilized and the plants must have a continuous supply of moisture close to the surface.

Broccoli requires large amounts of fertilizer, particularly nitrogen. As much as 100–200 pounds per acre of actual nitrogen may be applied during the growing season. Unless grown on land which has had liberal applications of phosphate, a phosphate fertilizer should also be added prior to planting.

Broccoli is field seeded, in the desert region, and then thinned when the plants are 2–3 inches high.

BRUSSELS SPROUTS (*Brassica oleracea var. gemmifera*) can be grown as a home garden crop, where they do very well. They are not a commercial crop in the area. They mature more slowly than cabbage but take the same cultural practices.

By protecting the plants with paper and palm leaf shelters the grower was able to plant these tomatoes on November 14. This photograph was taken on February 7 when the plants were blooming. Harvest will start about April 15 to 20.

CABBAGE (*Brassica oleracea var. capitata*) is grown successfully as a winter crop and is of importance commercially.

Culture. Commercial plantings are seeded directly in the field in September or October. Good clay loam soil is used. When the seedlings appear, they are thinned to 12–18 inches apart, in double rows 3½ feet apart. Frequent and light irrigations should be given. Fertilize the same as for Broccoli.

Harvesting is done from January to April.

CANTALOUPES (see Melons, on page 42).

CARROTS (*Daucus carota*) are grown as a winter crop and are important commercially in the desert region. They are not seriously injured by cold weather and so can be raised in colder locations than many other crops.

Culture. Carrots do well in a sandy loam soil. They are usually planted from August 15 through November. The seed is planted in beds in double or multiple rows from ¼ to ½ inch deep. The seed must be kept moist until it has germinated.

Both nitrogen and phosphorus are usually used for fertilizing carrots, but fertilizer practices in the area vary widely. A common practice is to broadcast the commercial fertilizer and then to form the beds. Large amounts of P_2O_5 per acre are used. On phosphate deficient lands rates up to 160 pounds of P_2O_5 per acre, and more, have been used. Weeds can be controlled by using petroleum (carrot) oils which are not injurious to the carrots.

CAULIFLOWER (*Brassica oleracea var. botrytis*) is grown commercially to a limited extent.

Culture of this crop is the same as that described for broccoli (see above). It does best on heavy land, but can be grown on lighter soils if plenty of fertilizer is used. Cauliflower requires both nitrogen and phosphate fertilizers.

CHICORY (*Cichorium intybus*) has been grown successfully in the desert region, but only on a small scale as a salad plant. Chicory is often confused with endive (*Cichorium endivia*).

Culture is the same as for lettuce (see page 41) except that the plants are spaced 6 inches apart in the rows.

CHIVES (*Allium schoenoprasum*) are strictly home garden plants, taking the same culture as for green onions (see page 42).

COLLARDS (*Brassica oleracea var. acephala*) are of little importance as a crop in the desert area. Culture is the same as for cabbage (see above) but collards require a longer growing period.

CORN (*Zea mays var. rugosa*). Sweet corn is well adapted to the desert region, the largest acreage being in the Coachella Valley. Most of the corn planted is of Golden Cross Bantam strain, which takes 75–110 days to mature, depending on planting time.

Culture. Sweet corn is grown on a wide variety of soils but does best on those of medium texture.

Some very early corn is planted in December and January in the warmer sections. In areas subject to late frosts it should not be planted until February 15. The main crop harvest starts about the first week in May and will run until approximately June 15.

The early corn is planted by a side hill planter hooked on just behind the bed shaper. The row is planted about half way between the bottom of the furrow and the top of the bed. The slope serves to trap heat and to carry away any salts beyond the roots of the young corn plants. Later planted corn is usually planted flat.

Sweet corn must have adequate moisture at all times. An especially critical period is from emergence to about 6 inches high, and again at tasseling and silking time.

Beds are spaced about 36 inches apart; the corn is thinned to 9–12 inches apart in the beds, after it has reached a height of about 4 or 5 inches. Suckering does not increase yields and is usually detrimental.

Sweet corn is a heavy feeder of nitrogen. Applications of actual nitrogen at the rate of 150–200 pounds per acre, one-half or two-thirds of it at planting time, and the rest as a side dressing before the plants are 6–8 inches high, is usually sufficient.

One pest, the corn earworm, does serious damage to corn in the desert area. The crop is not subject to many diseases. Spider mites have become a problem.

Some fall plantings of sweet corn are made. The standard spring varieties and selections are used. Planting starts about August 20 and extends to September 15. The harvesting period starts during late October and will extend until frost.

Acreages of fall sweet corn are limited because of the high cost of worm control and competition from other areas during the forepart of the harvesting period. The worm problem seems to decrease in the event of cool weather. The worms giving trouble are lesser cornstalk borer, beet army worm, corn earworm, and fall army worm. *The local office of the Agricultural Extension Service will have the latest pesticide recommendations.*

Harvest. Corn should be harvested in the early morning and artificially cooled to reduce the field heat to 38°F. Immediate cooling after picking preserves the sugars and results in a superior market quality. Corn is packed in crates of 4–6 dozen ears.

CUCUMBERS. (*Cucumis sativus*) are well adapted to most of the region and have been grown commercially, but have not generally done well on the sandy soils in the Coachella Valley.

Culture is roughly the same as that for cantaloupes, except that cucumbers require more frequent irrigation. (See Melons, page 42.)

They should not be planted in the open ground until after danger of frost is over. They have been planted in January under caps but only in the warm districts.

Fall crops are successfully grown from plantings made August 10 to 30.

Aphids, nematodes, mildew, and beetles MUST be guarded against. If the soil is infested with nematodes, it should be fumigated before planting.

DANDELIONS (*Taraxacum spp.*) are well adapted to the desert area and may be grown if desired. They require a sandy loam and the culture is the same as that recommended for lettuce.

EGGPLANT (*Solanum melongena*) is well adapted to the desert region and is usually grown in the warmer areas for out-of-season production. It is resistant to heat, but sensitive to frost.

Culture. Seed may be planted in muslin-protected seedbeds in July or August and later transplanted to the fields. In this case, it is harvested from November to January. If frost does not kill the roots, the plants may be cut back in February and will produce a spring and summer crop.

Seed can also be planted in the field in February or March, or plants can be grown under protection in the winter and transplanted to the field in March.

Eggplant requires an abundance of water and should be heavily fertilized. Mites and nematodes are serious pests of eggplant.

ENDIVE (*Cichorium endivia*) is often mistaken for chicory. It is well adapted to the desert region as a winter crop and its culture is the same as that for lettuce.

GARLIC (*Allium sativum*) has been grown commercially and is well adapted to the desert area. It belongs to the onion family and is grown from sets called cloves. New information indicates cold storage of the sets before planting is beneficial. When the plants are mature the leaves turn yellow, at which time they should be harvested. (See "Onions," page 42.)

KALE (*Brassica oleracea* var. acephala) is one of the common "green" crops that can be grown during the cooler months of the year. Its culture is the same as that recommended for cabbage (see page 39).

LETTUCE (*Lactuca sativa*) is one of the major crops of the desert region.

Soil. Lettuce succeeds on a variety of soils, but clay loams are regarded as being the best. However, high yields of excellent quality are produced on clay soils and many growers prefer silty clay. Sand blows into the heads on sandy land.

Seedbed preparation should be very thorough. Lettuce is generally grown in rotation with alfalfa. The soil should be carefully leveled to insure perfect irrigation. The lettuce is planted in beds 42 inches apart. Where possible the lettuce beds are run north and south so each side of the bed will get an equal amount of sun.

Planting. The seed is drilled in double rows about 12 inches apart on each of the beds, and later thinned so the plants are about 12 inches apart in the rows. Plantings are made from August 20 to December 1. Thinning is done when the plants have 2–4 true leaves. Harvest is from mid-November to early April. Lettuce seed does not germinate satisfactorily when temperatures are 105°F or higher.

Considerable moisture should be present at all times from seeding to maturity but the tops of the beds should not be flooded.

Fertilization. Both nitrogen and phosphate fertilizers are needed for maximum yields of high quality lettuce. From 30–120 pounds of actual nitrogen is applied. More nitrogen is applied on

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For latest information on pest and disease control measures, see your University of California Farm Advisor.

late planted lettuce than on early lettuce. Frequently 120–160 pounds P_2O_5 is applied before planting along with about ⅓ of the total nitrogen. There seems to be no need for potash in this area.

MELONS (*Cucumis melo*). Cantaloupes, including Honeydews and Honeyballs, are the most important melon varieties grown in the desert region, and their culture is similar except for spacing and planting time.

Culture. Good loamy soil and a thoroughly prepared seedbed are essential to the heavy production of melons. Alfalfa land is especially suitable.

All melon varieties related to the cantaloupe are grown on raised beds and irrigated by the furrow method. The rows should run east and west, with the beds sloped to the south. The seed is planted on the south side of the beds, and the vines trained to the north over the tops of the beds, and thus contact of irrigaion water with the fruit is avoided.

Melons planted prior to February 15 are protected by caps. They should not be planted in the open until after danger of frost is past.

Nitrogen and phosphate fertilizers are required for maximum production. Sixty to 120 pounds of nitrogen and 120 pounds P_2O_5 per acre is a typical fertilizer program for melons.

Melon diseases and pests are numerous. See your farm advisor for latest information.

OKRA (*Hibiscus esculentus*) grows well in the desert area. It is valuable for its edible pods which are used in soups and stews and in many other ways for flavoring.

Culture. Okra may be planted in the open, as soon as danger from frost is over, and will succeed when planted as late as July.

The young pods should be picked about every second day, during the fruiting season, because they grow very rapidly and soon become tough.

ONIONS (*Allium cepa*) are grown in the desert region, but only to a limited extent because of competition by the early onions from other areas.

Culture. All varieties of onions are grown best on medium to heavy soils. The soil should be free from pink root disease.

These photos show three important desert area vegetable crops. At left is a field of cantaloupes being harvested in the Palo Verde valley. The center picture shows a field of fall planted lettuce.

Heaviest yields are obtained from the Grano varieties and new hybrids such as Granex.

Both field seeding and transplanting are practiced. Transplants are grown in beds like field seeded onions but are seeded very heavy. A carrot shoe on the planter is used to scatter the seed.

Onions are planted 2 rows per bed on beds 36–42 inches center to center.

About 100 pounds of nitrogen and 120 pounds of P_2O_5 is used at planting time in the beds and additional nitrogen may be side-dressed when the onions are 4–6 inches tall.

Weed control is a MUST in onion fields. Cultivation and hand weeding have been done in the past. Several selective weed killers are showing great promise.

A local farm advisor should be consulted for the latest chemical weed control methods.

Thrips should be controlled during the entire growing season through the use of the proper insecticides.

PEPPERS (*Capsicum spp.*) require considerable care but have been a good crop when grown in favorable localities.

Culture. Pepper seed is usually field planted on south-sloping beds from September 25 to November 1, with the main planting dates from October 1–15. Most of the peppers are field seeded. Occasionally some growers transplant pepper plants from the thick field seedings to other fields. If there is danger of frost these transplants have to be sheltered. Pepper plants are set back considerably by transplanting. Field plantings are frequently thinned by clipping off the surplus plants close to the ground. Pulling surplus plants may disturb the roots of the plants left.

Peppers must be protected during the winter against frost. "Shelters," made of 18 to 24-inch kraft paper, are put in on the north side of the plant row and are slanted south over the pepper row. The kraft paper is held in place by lath on either side of the paper. The lath are held in place by a top wire anchored to posts. The shelter gives considerable protection against frost and traps the heat from the winter sun.

A sandy or sandy loam soil is desirable. Peppers require frequent irriga-

(Continued on page 46)

At the time this photo was taken (December 20) the lettuce crop was about three weeks from harvest. At the right carrots planted in August or September are dug in the winter.

Planting Calendar for Vegetable Crops

Crop	Adaptability	Quality or use	Variety recommended	Best time to plant	Pounds seed per acre	Distance apart of rows	Spacing of plants in row	Date mature for harvest	Average yield per acre
Artichokes	Fair	Poor	Green Globe	Dec. 1–Feb. 1	2,722 plants	48″	48″	Apr. 1–June 1	1½ tons
Asparagus	Good	Good	Mary Washington 500	March	5	60″ double	2–4″	Feb. 1 and later	60–80 crates
Beans (green)	Good	Good	Blackeye #5	Aug. 1–Sept. 1	80	36″	2″	Oct.–Nov.	4,000 lbs.
Beans (green)	Good	Good	Black Valentine, Blue Lake & Wade	Aug. 5–Sept. 15 Feb.–Mar.	80–100	36″	2–4″	Oct. 15 to frost April and May	4,000–5,000 lbs.
Beans (green)	Good	Excel.	Kentucky Wonder	Aug. 5–Sept. 15 Feb.	40–60 40–60	36″ 36″	2–4″ 2–4″	Oct. 15 to frost Apr.–May	4,000–5,000 lbs. 5,000–6,000 lbs.
Beans (green)	Poor	Good	Lima types	July 15–Aug. 15 Mar. 15–Apr. 15	70	36″	3–4″	Nov. 1 to frost July–Aug.	
Beets	Good	Good	Crosby's Egyptian	Sept. 20–Jan. 1	8–10	42″ double	6″	10 weeks after planting	
Broccoli	Good	Excel.	Green Sprouting	Sept. 15–Oct. 15	1½	36–42″	12–18″	Feb. 1–Apr. 1	
Brussels Sprouts	Fair	Fair	Improved Half Dwarf	Sept. 20–Oct. 30	2	36–42″	12–18″	Jan. 1–Apr. 15	
Cabbage	Good	Good	Copenhagen Market	Sept. 1.–Oct. 15	2	36–42″	12–18″	Jan. 1–Apr. 15	7–12 tons
Cantaloupes	Excel.	Excel.	Mildew-resistant strains	Dec. to March	2	84″	capped 18″ open 12″	May 10–July 15	160 crates
Carrots	Excel.	Excel.	Imperator	August	2–3	42″ multiple rows	not thinned	Oct. 15–Dec. 1	250 crates
Cauliflower	Good	Excel.	Snowball types	Sept. 1–Oct. 15	3	42″	18″	Jan. 1–Apr. 15	
Chicory	Good	Good	Witloof	Sept. 20–Nov. 1	4	42″ double	6″	Dec. 1–Feb. 15	
Chives	Fair	Fair	Commercial seed	Sept. 1–Mar. 1	3	36″ double	3″	Spring	
Collards	Fair	Good	Georgia	Sept. 1–Oct. 15	3	42″ double	12–18″	Jan.–April	
Corn	Excel.	Excel.	Golden Cross Bantam strains	Jan. 1–Mar. 15 Aug.	8–10	36″	9–12″	May 1–July 1 Oct.–Nov.	
Cucumbers	Good	Excel.	Colorado, Straight Eight, Marketer	Dec. 1–Feb. 25 Aug. 10–Oct. 5	2	60–84″	24–36″	April and later or Oct. and later	3–10 tons
Eggplant	Good	Excel.	N.Y. Improved Black Beauty	Bed—June 15–Jul. 1. Transplant Sept. 1–15	¼ plntd in beds will transplant to an acre	36″	24″	Nov. 15 to frost	200 lugs
				Field seed or cutback Feb. 1–Mar. 1	2	36″	24″	May 15–June 15	
Endive	Good	Good	Green Curled	Sept. 10–Nov. 1	4	42″ double	12″	Dec. 1–Feb. 15	
Garlic	Good	Good	Early White or Mexican, Late Pink or Italian	Sept. 10–Jan. 1	900 pounds Cloves	36″ double	3″	May 1–July 1	5,000–7,000 lbs.
Kohlrabi	Fair	Good	Early White Vienna Early Purple Vienna	Oct. 1–Nov. 30	4	36″ double	6″	Feb. 1–Mar. 30	

			Imperial and Great Lakes strains	Sept.–Nov.	3	42″ double	12″	Nov. 20–Apr. 15	300 cartons
Melons:									
Casaba	Fair	Good	Golden Beauty	Feb. 20–Mar. 20	2	84″	24–48″	Aug. 1–30	500–800 flats
Honeyball	Excel.	Excel.	Commercial varieties	Dec. 20–Mar. 20	2	84″	12–24″	June 5–June 20	200 crates
Honeydew	Excel.	Excel.	Com'l. var.	Dec. 20–Mar. 20	2	84″	24–48″	June 1–July 15	500 flats
Persian	Fair	Excel.	Com'l. var.	Apr. 1–Apr. 15	2	84″	24–48″	Aug. 1–Aug. 30	500 flats
Mustard (for greens)	Good	Good	Southern curled	Sept. 20–Jan. 1	2	36″	4–12″	Nov. 1–Mar. 15	
Okra	Excel.	Excel.	White Velvet, Clemson Spineless	Mar. 15–June 5	6–8	36″	12–24″	May 25–Nov. 15	300 lugs
Onions (dry)	Excel.	Excel.	Excel, Crystal Wax, Texas Early Grano	Direct seed Oct. 5–10	4	36–42″ double	2–4″	Apr. 20–June 1	250–500 sks.
				Seedbed Sept. 10–Oct. 1	2 per acre to be plntd.	36–42″ double	4″	Apr. 20–June 1	250–500 sks.
				Transplant Nov. 1–15					
Onions (bunching)	Excel.	Excel.	Southport White Globe, Utah Sweet Spanish	Aug. 15–Oct. 1	15	24–32″	Not Thinned	Nov.–Dec.	200–300 crates
Parsley	Good	Good	Moss Curled	Oct. 1–Jan. 1	3	36″ double	8″	Jan. 1–May 1	100–150 crates
Parsnips	Good	Good	Hollow Crown	Oct. 1–Nov. 15	3	36″ double	4″	Feb. 1–Apr. 1	125 crates
Peas	Good	Good	Laxton's Progress Morse's Market	Sept. 15–Oct. 15	60–80	36″ double	2–4″	Dec. 15–Apr. 1	200–400 lugs (21 lbs.)
			Mammoth Melting Sugar (edible pod) pole	Sept. 15–Oct. 15	25–40	72″	2–4″	Dec. 15–Apr. 1	200–400 lugs
Peppers	Excel.	Excel.	California Wonder	Sept. 25–Nov. 1	2–3	36″–40″	12–16″	Apr. 20–June 20	8,000 lbs.–16,000 lbs.
Pimiento	Good	Good	Perfection	Sept. 15–Nov. 1	2	36″	24″	Apr. 1–June 15; second growth, Oct. 20 to frost	
Peppers (hot)	Good	Good	Floral Gem, Fresno Jalo Pino	Oct. 1–15	4–6	36″	10–14″	Apr. 1–June 15	200–300 lugs
Potatoes	Poor	Good	White Rose, Bliss Triumph	Jan. 15–Feb. 15 Sept. 1–Sept. 20	1,000–1,400	36″	15″	May 15–June 15 or Dec. 1 to 30	10,000 lbs.
Pumpkins	Good	Good	Kentucky Field Striped Cushaw Boston Marrow	Mar. 1–July 1	3	72–96″	24–48″	Aug. 1–Dec. 1	15 tons
Radishes	Good	Good	Com'l. var.	Sept. 1–Apr. 1	10	36″ double	1″	Oct. 1–May 1	
Roselle	Good	Good	Com'l. var.	Mar. 1–Apr. 30	3–5	72″	24–36″	Oct. 1–Dec. 15	
Salsify	Good	Good	Sandwich Island	Sept. 15–Nov. 15	8	36″ double	4″	Dec. 1–Mar. 15	
Spinach	Good	Excel.	Prickly Winter	Sept. 1–Dec. 15	15	36″ double	3–6″	Nov. 1–Apr. 1	200 crates
Squash (summer)	Excel.	Excel.	Early Bush	Aug. 1–30 or Dec. 1–30	3	18″ single 48″	36″	Oct. 15–Dec. Mar. 20–May 20	800–1,000 flats
			Scallop, Zucchini, Yellow Crookneck						

Planting Calendar for Vegetable Crops (Continued)

Crop	Adaptability	Quality or use	Variety recommended	Best time to plant	Pounds seed per acre	Distance apart of rows	Spacing of plants in row	Date mature for harvest	Average yield per acre
Squash (winter)	Good	Good	Hubbard, Banana, Table Queen	Aug. 1–Aug. 20 or Feb. 1–Mar. 15	3	72–84″	24–36″	Oct. 1–Dec. Mar. 20–May 20	
Sweet Potatoes	Good	Good	Porto Rico Yellow Jersey	Hotbed, Dec. 15 Jan. 15; field Feb. 15–Mar. 15	40 lbs. potatoes; 14,520 plts.	36″	12–15″	Jul. 20–Oct. 1	5–8 tons
Swiss Chard	Good	Good	Lucullus	Sept. 1–Jan. 1	8–10	36″	12″	Dec. 1 to spring	
Tomatoes (market)	Good	Good	First Early, Early Market, Earliana, Pearson, Pennhart	Aug. 1–Sept. 1 Oct. 15–Dec. 1	1½	72″	12″	Nov.–Apr. Apr.–July	1,000–1,500 lugs
Tomatoes (canning)	Good	Good	Same as for market	Feb.	1½	72″	12–18″	June–July	10 tons
Turnips	Good	Good	Purple Top Globe Early Snowball	Sept. 1–Nov. 30	3	36″ double	3–4″	Dec. 1–Apr. 1	500 crates
Watermelons	Excel.	Excel.	Peacock Klondike types	Dec. 15–Mar. 15	1½–2	72–96″	3″	May 15–July 20	7–12 tons

tion, and must be kept free of weeds. Growers use heavy fertilization with manures and commercial fertilizers. *They are subject to many diseases and pests.*

POTATOES (*Solanum tuberosum*) are not well adapted to the desert area, being sensitive to both the heat of summer and the cold of winter. Yields have been comparatively low (only a few yields of over 10,000 pounds per acre have been secured) compared with the recognized potato-growing areas.

Culture. When grown, potatoes should be planted early to take advantage of the relatively short spring season. Early maturity is essential to secure highest prices.

The soil should be kept uniformly moist by frequent light irrigations. Applications of 150 pounds of nitrogen per acre have been used for best results.

PUMPKINS (*Cucurbita pepo*) are well adapted to the desert region and all varieties do well, but the pumpkin crop is of minor importance commercially.

Good results are obtained from spring or early July plantings.

RADISHES (*Raphanus sativus*) are well adapted and do best in the lighter-textured soils.

They may be planted at intervals from September 1 to April 1. Seed should be planted in a deep, well-prepared soil and irrigated frequently for quick growth, to produce crisp, tender roots. They are not grown commercially.

ROSELLE (*Hibiscus sabdariffa*). The buds and young leaves of this plant are used in jelly making and the plant grows well in the desert region. Roselle requires a long growing season, and seeds should be planted in the spring after danger of frost is over.

SALSIFY (*Tragopogon porrigolius*) may be grown by the same cultural methods recommended for carrots (see page 39).

SPINACH (*Spinacia oleracea*) is well adapted to the desert region. It is grown during the cooler months from fall to spring. It is planted in double rows and takes about the same cultural practices as those given for lettuce (see page 41).

SQUASH of both winter and summer varieties grows well.

Summer squash (*Cucurbita pepo*) is usually planted in the warmer locations for winter or early spring production. Plantings made during the winter are protected by caps, or kraft paper shelters.

Winter squash (*Cucurbita maxima*) acreage has been small because there is no particular advantage to growing this crop in the desert. Plantings can be made in August for winter production, or in the early spring for early summer production.

SWEET POTATOES (*Ipomoea batatas*) have been important as a commercial crop purely because of early maturity—yields have not been too satisfactory. The main varieties grown have been Jerseys and Porto Rican types.

Culture. Sweet potatoes are best adapted to sandy soils—too much sand in the soil, however, causes difficulty in maintaining moisture and plant food in the root zone.

Sweet potatoes are placed in artificially heated beds established in late December and many shoots, or plants, grow from each sweet potato. The plants are transplanted in the field in late February or early March. The earlier the plants can be transplanted in the warmer areas, the earlier and better the crop will be. *The plants are sensitive to cold, and should not be put in the open field until danger of frost is over.*

Space the plants 12–14 inches apart in rows about 36 inches apart. They are normally ridge-planted, fertilizer being applied in the band alongside the young plants.

Transplanting into light soil is usually done at a time of year when the wind hazard is severe. It is generally desirable to provide windbreaks at frequent intervals across the field.

The crop is usually harvested in July and early August to reach the market well ahead of the regular producing areas in other parts of southern California.

TOMATOES (*Lycopersicum esculentum*) have been grown successfully for "off season" production in the warmer locations of the desert for many years.

The main spring harvested varieties are Earliana, First Early and Pennhart, with First Early and Earliana being the first to mature. They are planted in October and November. Plantings for fall and winter harvest are made in August and September only in warmer sections of the valleys. The Pearson variety is included for the winter harvest. Spring plantings for fresh market or canning tomatoes are made in February. First Early, Early Pack and Pearson are the varieties being used.

Seed is planted directly in the field, on beds 6 feet apart. Three to five tons of barnyard manure per acre are commonly applied. Frequently the manure is put in a trench under where the row is to be. The roots of the young plants reach down into this mass of decaying manure, make a good start and continuous growth.

The plants are sheltered with paper shelters to prevent excessive radiation of heat from the soil during cold nights,

DISEASES AND PESTS

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and to trap heat during the day. The shelters should be exposed to the south and may be removed early in February, when the soil begins to warm up and the plants begin to grow more rapidly.

Staking. In the Coachella Valley tomato plants are trained upright on lath held by wires and posts that support the shelters. In the Imperial and Palo Verde valleys, the plants are allowed to lie on the ground.

Plants are thinned to about 10–18 inches apart in the rows.

Harvesting. The August–September planted crop matures in November and December and picking continues into February or March; the October–November planted crop begins to mature in late April, with peak production in mid-May and into early June. The February open-planted crop starts producing in June and picking continues as long as weather or markets permit.

The first 5 or 6 strong flower clusters on the October–November planting are the most important fruits from the standpoint of monetary return. The use of hormone materials for setting fruits under cool temperature conditions has proved beneficial.

With the coming of extreme summer weather the tomatoes rapidly deteriorate.

The growing of tomatoes is an exacting business as the plants are subject to a wide variety of troubles. Details on tomato growing, many of which apply to the desert region, will be found in the following publications: Ext. Cir. 167 Tomato Production in Calif., Ext. Cir. 160, Tomato Propagation, by P. A. Minges, J. B. Kendrick, J. E. Spurlock, and D. M. Holmberg, USDA Bul. 1934, Tomato Diseases.

WATERMELONS (*Citrullus vulgaris*) are well adapted to the desert region, which is noted for early production of melons of excellent quality.

Culture. Watermelons are grown on sandy loam and loam soils. The use of heavy clay should be avoided.

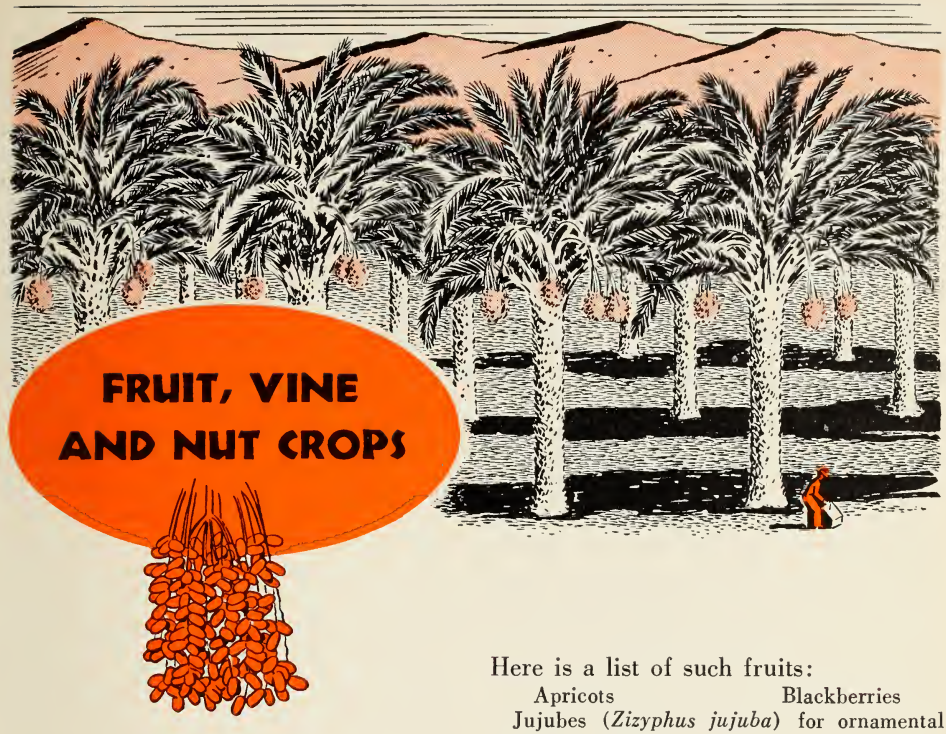
Planting is done under caps from December to February, or in the open field after danger of frost is over. Watermelons are usually planted in beds 7–9 ft. apart, with a slope toward the south. Nitrogen and phosphate fertilizers are used as a general rule.

Watermelon wilt is present in the area, so only wilt-resistant varieties should be planted. Watermelons are ordinarily not grown on the same land oftener than once every 4 or 5 years.

CAUTION

The enactment of recent legislation dealing with residues of agricultural pesticides allowable with raw agricultural products makes it necessary for growers to apply only chemicals for which established tolerances have been set.

For this reason, check with your local agricultural authorities to see that your insect-control program does not constitute a violation of the present law. For certain hazardous materials, at certain levels, it is necessary to post fields with "poison out" signs and obtain permits to conform to state and local laws.



FRUIT, VINE AND NUT CROPS

Since as long ago as 1912, a great many experimental plantings of fruit, vine, and nut crops have been made at the University of California's Field Station in the Imperial Valley. Only a short time was needed before the experiments began to show that the desert area was not likely to be an important area for deciduous tree fruits. However, grapes, dates, and citrus fruits are becoming increasingly important, especially in the Coachella Valley.

Most fruits cannot be recommended for commercial planting in the desert region and their past performance has shown that they will not even do well in the home garden. Here is a list of such fruits that have been eliminated:

Almonds	Cherries
Apples	Gooseberries
Avocados	Guavas
Bananas	Mangos
Pineapples	

Some fruits, while not recommended for commercial planting, may be grown with very moderate success for home gardens. Here is a list of such fruits:

Apricots Blackberries

Jujubes (*Zizyphus jujuba*) for ornamental purposes, mainly.

Kumquats (*Fortunella spp.*) need protection against frost.

Limes Loganberries

Loquats (*Eriobotrya japonica*) for ornamental purposes.

Mulberries (*Morus spp.*) for shade trees.

Olives Peaches Plums

Quinces Raspberries

Location is all important in the planting of orchards and vineyards. Because trees and vines represent important investments and must pay off over a long period of time, only proven soils and areas should be chosen for them. Warm locations are important especially for citrus and grapes. Very fine sand to sandy loam soils are ideal and they should be free of salinity as well as properly drained. If the water table cannot be drained to below five feet, it is questionable whether trees and vines can long succeed.

Preparation for planting fruit crops involves:

Development of a good water supply. It is desirable to have a flow of

about 1½ Southern California Miners inches (13.5 gpm) or *more* of water available for each acre of orchard or vineyard planted. By this rule of thumb for a forty acre planting, a sixty inch well (540 gpm) or other water source would be required. The water must be of good quality. Boron content should not exceed 0.7 part per million for best results.

Leveling the land. Orchards and vineyards may be irrigated by furrows, strip checks, basin checks, or under certain conditions, perhaps by overhead sprinklers. The method to be used will determine the type of leveling that must be done for success of the crop and efficient use of water. In general, requirements are not as exacting as for flat irrigated crops such as alfalfa or as for bed planted crops such as vegetables. This makes it possible to avoid expensive benching of land in most cases. In any case the grade chosen should be as uniform as possible and on the sandy soils, runs should be short (330 feet). On heavier soils it is very important that grades be rather flat. Reservoirs and return flow systems for controlling run-off water are valuable in many situations.

Piping or ditching for irrigation: On sandy soils with steep slopes such as are being planted to fruit crops, pipelines to carry irrigation water are almost a necessity. The trend is to larger pipes and valves especially on light soils where large flows of water may be required for efficiency. The pipe system should be properly engineered for the water supply.

Preparation of the soil: In the case of raw desert soil, it is well to run soil salinity tests first to determine whether leaching will be required. A salinity content in excess of 4 millimhos indicates that leaching may be desirable. Suggestions for this operation are to be found in Extension Service Pamphlet "Salinity and Drainage in the Coachella Valley" and "Control of Salinity in the Imperial Valley, California," ARS, USDA, Dec., 1955. After leveling, piping and leaching are completed, an annual cover crop such as barley is first established. This is best done in early October. If growth of barley is generally poor because of salinity, further leaching and farming to annual crops should be done before trees and vines are planted. Where only occasional salty spots of heavier soil are encountered, these may sometimes be removed by the land leveler and replaced with good soil. ***In no case will it pay to set trees or vines in soil where a satisfactory growth of barley cannot be obtained.***

Trees or vines may be set in the standing cover crop in March or later without further preparation. It is most important that everything be done to give the plants a uniform and vigorous start the first year. Frequent irrigation is required. Only very small amounts of fertilizer should be used until the plants are well established. On white (sandy) soils, the reflected sunlight may burn the trunks and foliage of young trees, and in this case, it is well to plant some summer annual such as soybean, Sesbania, and even Sudangrass. The trunks of all trees should be whitewashed to prevent sunburn during the first few years.

DATES (*Phoenix dactylifera*) are ideally adapted to the desert region. In 1955, 4,748 acres, about 90 per cent of the date acreage of the United States, were located in the area. The relatively high temperature and low humidity, together with good soil and an abundance of water make a natural environment for date culture.

Varieties. Not all varieties are adapted to the same conditions. The Deglet Noor variety is planted on most of the acreage. It requires higher temperatures and lower humidity than many of the other varieties, and is well adapted to the Coachella Valley area of the desert region. It is more sensitive to moisture on the fruit (rainfall or excessive humidity) than many of the other standard

varieties. It produces a high quality fruit on light soils such as are found in the Coachella Valley.

The softer varieties, Khadrawy, Halawy, and Barhee have generally been superior in the Imperial, Bard and Palo Verde valleys. A more recently introduced variety, the Medjool, is becoming more important, principally because of its large size.

Only offshoots of palms of known variety and production performance should be planted.

Soils. Dates can be grown on a wide variety of soil types but they do best in good soils of the loamy sand and sandy loam types. They will survive on heavy soils containing alkali, but will not produce satisfactory commercial crops.

Preparation. The commercial life of a date planting is 40 years or more. The palms will live much longer, but grow so high that handling is expensive.

Since a date garden is a long-time investment, it should be planted properly; the land and soil selected carefully, the leveling done accurately. An adequate irrigation system should be installed and an ample supply of water assured.

Experience has shown that at least 10-acre feet of water per year is necessary for good production on bearing palms. In the summer, dates are irrigated every 10 to 14 days; in the winter, every 30 to 40 days.

Planting offshoots. While date palms can be grown from seed, no two seedling palms are alike and only a few seedlings produce fruit of good quality.

Thus plantings should be made from offshoots taken from trees of proven quality. The offshoot is exactly like, and produces fruit exactly like, the parent palm.

Offshoots develop during the early life of the palm, from buds on the trunk. When the offshoot is 3 to 5 years of age it can be removed from the parent and planted in the field or nursery. Offshoots are usually removed anytime between April and July.

Normally vigorous offshoots will begin to produce commercial crops in from 4 to 5 years after planting.

Culture. For detailed cultural information on dates, see U.S.D.A. Cir. 728, "Date Culture in the United States," and U.S.D.A. Leaflet 170, "Date Growing in the United States."

FIGS (*Ficus carica*) are reasonably well adapted to the desert region and many varieties (Beall, Brown Turkey, and Mission) have been grown successfully. However, the figs do not drop readily and local conditions for drying are unfavorable, so the crop should be marketed as fresh fruit. The early market for fresh figs is rather limited—a factor limiting profitable production.

Fig trees usually bear some fruit when they are one year old, and if well cared for, produce heavily at 4 years old. Plenty of water should be applied to the trees and the fruit should be thinned if large sizes are desired. Figs are very susceptible to nematodes. One crop a year may be expected.

GRAPEFRUIT (*Citrus paradisi*) is an important fruit crop in the desert region —trees produce an abundance of exceptionally high-quality fruit.

The ideal soil is a sandy loam, reasonably free from alkali, having good drainage and containing a good supply of plant foods. Heavy clay soils, or soils

DISEASES AND PESTS

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FARM ADVISOR

containing alkali should be avoided. The method of preparing the land for grapefruit is discussed on page 49.

Windy, cold or saline locations should be avoided for grapefruit. A windbreak of closely planted grapefruit, tamarisk, or Eucalyptus may be helpful in some locations, especially while the trees are getting started. Temporary windbreaks of palm fronds may be used while the living windbreak is becoming established.

The trees need special protection against frost, sunburn, and insects while they are young. Trunks should be protected with heavy wrappings of newspaper during the winter and be covered with trunk protectors during the first summer at least, while they are establishing enough leaf surface to protect the trunks against sunburn.

Young trees need inspection frequently, the first year, especially. Ants occasionally girdle small trees unless they are protected with insecticides. Thrips are very damaging to young growth unless it is periodically treated.

GRAPES (*Vitis spp.*). Grapes produced in the lower desert regions are the first to reach the markets in early summer. All grapes shipped during June and until early or mid-July are from this area. During this period the markets of the entire United States are supplied. Because the earlier fruit usually commands a higher price, a warm early location is desired for the vineyard.

The following cultural suggestions apply to the grapes raised in the desert area only.

The soil should be free from alkali and well drained. If ground water is at a level nearer than 6 feet from the surface, the land should be avoided for grapes.

Varieties. Thompson Seedless is by far the most important variety grown. Cardinal has, in recent years, replaced the Red Malaga as the most important colored grape because it is somewhat earlier. Perlette, a University of California variety, about ten days earlier than Thompson Seedless, but otherwise very similar to it, is now being planted extensively in the Coachella Valley in early locations. Another University of California variety, the Beauty Seedless, shows promise as an early colored seedless grape.

Irrigation. Irrigation of grapes begins in February after pruning and French plowing have been completed. Irrigation is generous and frequent until the berries begin to soften when lesser amounts are applied at wider intervals to slow shoot growth and hasten maturity of the fruit. After picking, several more irrigations are given before the vines go dormant.

It is desirable to irrigate young vines more frequently, applying the water close to the vine row.

Time of ripening of the Thompson Seedless ranges from June 6, in the warmest areas, to July 15 in the cooler areas. In general the earliest grapes are produced in the warmest areas and on sandy soils.

Protection. Wind may cause severe damage to young vines during the first year or two after planting. As added wind protection grapes are frequently planted with a nurse crop of barley or other cereal.

LEMONS (*Citrus limonia*). Lemons have been planted to some extent in the last few years in the more frost-free areas of the desert region. Lemon trees are sensitive to frost, salinity and high water-tables so warm well-drained soils should be chosen. The vigorous rough lemon rootstock has been most commonly used and has resulted in good early production

In the picture at the right Thompson seedless grapes are picked by hand and carefully packed during June or July. They are shipped by refrigerated car to fresh fruit markets all over the nation.

and rapid growth of the trees. Diameter of the tops of these trees has increased at a rate of two to two and one-half feet a year indicating the need for a rather wide spacing of rows. Trees within the rows have been double planted in many cases with the idea of forming hedge rows or of thinning out as the trees begin to crowd. Tree spacing in the row has varied from 15 to 24 feet and rows have been planted from 24 to 28 feet apart.

The fruit is large, juicy, somewhat more acid than the coastal fruit and of very acceptable quality. In contrast to the coastal lemons there is only one bloom and one crop per year which matures from October through December. It is sometimes possible to have most of the fruit picked before serious cold temperatures occur.

Brown rot gummosis of the trunk bark at the ground level, has been the only serious disease encountered. Trees should be planted so that soil does not accumulate around the trunk of the tree. The Coachella Valley is a red scale-free district and about the only other serious insect trouble is from the thrips attacking new growth and fruit. More experience is needed to determine average production in comparison with that of coastal areas. Per acre costs of production should be somewhat lower.

ORANGES (*Citrus sinensis*) : the Valencia type orange is grown commercially to some extent in the Coachella Valley because it ripens during the winter months. The Washington Navel Orange grows well in the desert region, but the fruit does not have the fine flavor that it does when grown in more favorable areas.

Oranges should be planted on sandy loam soils that are reasonably free from alkali, and which have good drainage.

Since rootstocks and strains of citrus are important considerations for any plantings in the region, the prospective grower would do well to consult the local office of the farm advisor for the latest information on this subject.

PEACHES (*Amygdalus persica*) do not produce satisfactorily in the desert. Even the "low-chilling requirement" peaches produce very few peaches, so they cannot even be recommended for home fruit orchards.

PECANS (*Hicoria pecan*) will grow well and set good crops under favorable conditions.

Pecans have not been commercially profitable because other areas have been able to produce them much cheaper than this area.

Pecans do best in deep, sandy, or sandy loam soil that is practically free from alkali. Several hundred acres have failed due to one or more of the following causes: high water table, alkali, heavy soil, or possible zinc deficiency.

PERSIMMONS (*Diospyros spp.*) of the American species have been a failure, but the Japanese varieties have done comparatively well. The Hachiya and Tanenashi varieties have produced fruit of very acceptable quality.

The trees are extremely susceptible to sunburn and must be well protected.

To date the crop is of no commercial importance, but is popular in home plantings.

PLUMS of the European (*Prunus domestica*) and Japanese (*Prunus salicina*) species have not been commercially profitable in the desert region. The European prune varieties should not be planted. Many plum varieties do best when cross-pollinated, so plantings should be arranged to provide this (see University of California Cir. 424). Some varieties of plums might be planted in home orchards.

POMEGRANATES (*Punica granatum*) have little commercial demand, but the trees do well in the desert region, and are often used for decoration and for low windbreaks.

Pomegranates are easily propagated by cuttings, are adapted to a variety of

soils, and are even somewhat alkali tolerant. The fruit is exceptionally good and highly attractive.

QUINCES (*Cydonia oblonga*) do comparatively well and produce yields of excellent quality, but again, as with pomegranates, there is little commercial demand for this fruit.

They are not exacting as to soil requirements, but need a reasonable amount of care. They can be included in home plantings.

STRAWBERRIES (*Fragaria spp.*) have been grown commercially in the desert region for many years. They succeed reasonably well, but require considerable skill and understanding on the part of the grower.

Cultural hints. Do not plant strawberries on alkali soil; use only hardy varieties, of proven value, and those which produce an abundance of foliage (to protect the fruit against the heat). They should be planted in relatively frost-free locations so that they will produce early in the spring.

Plant in sandy loam and give frequent irrigations.

Since earliness of maturity is the principal advantage gained in the desert region, all cultural practices should be geared to attain this goal.

TANGERINES (*Citrus nobilis var. deliciosa*) do well in the desert region and have produced good yields of high-quality fruit. They have about the same cultural requirements as oranges.

Algerian tangerines do not self-pollinate satisfactorily. Dancy tangerines or other citrus that will pollinate Algerians should be interplanted.

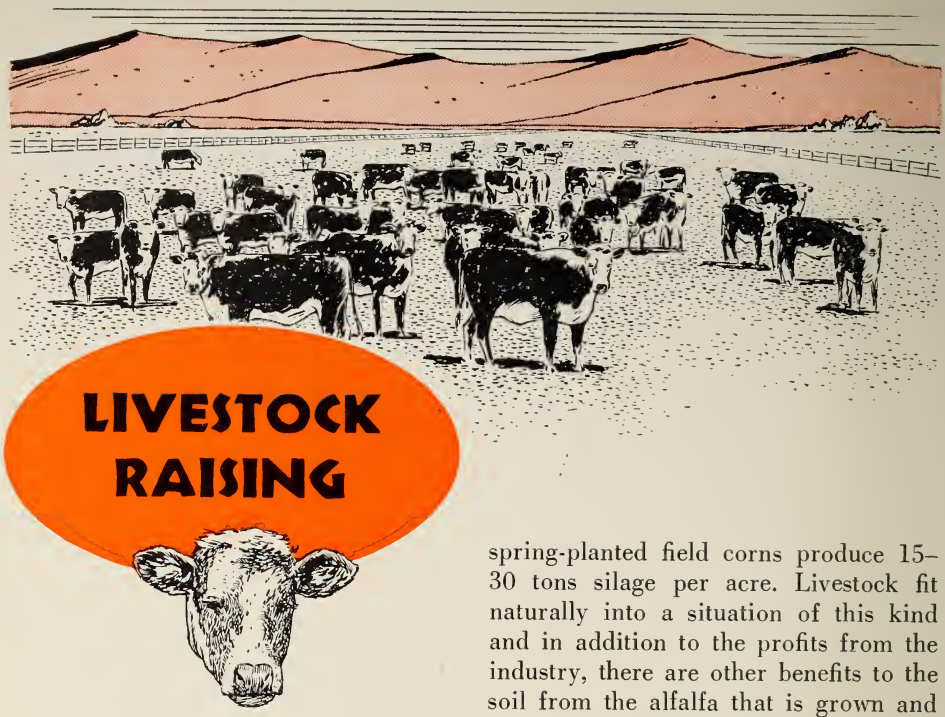
Before planting tangerines, however, the grower would do well to consult the local Farm Advisor's office for the latest information on varieties, rootstocks, and cultural practices.

Mature date palms being flood irrigated. Ten to 12 acre feet of water per year are used. Pruning, dethorning, pollinating, picking, and other operations require climbing these palms 10 or 12 times a year.

Crop	Adaptability	Quality or use	Variety recommended
Almonds	Poor	Fair	Nonpareil and Texas
Apricots	Fair	Fair	Royal, Earligold
Blackberries	Fair	Good	Boysenberry
	Poor	Good	Youngberry
	Poor	Good	Crandall
Dates	Excel.	Excel.	Deglet Noor
	Excel.	Excel.	Medjool
	Excel.	Excel.	Barhee
	Good	Excel.	Saidy
	Excel.	Excel.	Khadrawy
	Excel.	Excel.	Halawy
	Excel.	Excel.	Zahidi
Figs	Fair	Good	Brown Turkey, Beall
	Fair	Good	Mission King
Grapefruit	Excel.	Good	Ruby Blush
	Excel.	Excel.	Marsh Seedless
Grapes	Excel.	Excel.	Thompson Seedless
	Excel.	Excel.	Perlette
	Excel.	Good	Cardinal
	Excel.	Good	Red Malaga
	Excel.	Good	Ribier
	Excel.	Excel.	Beauty Seedless
Lemons	Fair	Good	Lisbon
	Fair	Good	Eureka
Limes	Fair	Good	Bearse Seedless
	Fair	Good	Mexican
Loquats	Fair	Good	Thales
Mulberries	Good	Good	Black Spanish
Olives	Fair	Good	Mission, Manzanillo
Oranges	Good	Excel.	Valencia
	Good	Excel.	Butler
	Fair	Good	Navel (home use)
Peaches	Fair	Fair	Honey Peento
	Fair	Fair	Robin, Redwing, Ventura
Pears	Poor	Fair	Winter Bartlett
Pecans	Fair	Good	Success, Mahan
Persimmons	Fair	Good	Hachiya, Tananashi
Plums	Fair	Fair	Santa Rosa
Pomegranates	Good	Good	Wonderful
Quinces	Poor	Good	Smyrna
Strawberries	Fair	Good	Lassen
Tangerines	Fair	Excel.	Dancy
	Fair	Excel.	Algerian

Fruit and Nut Crops

Best time to plant	Plants or trees per acre	Distance apart of rows, feet	Spacing of plants in row, feet	Date mature for harvest
1/1–2/28	76	24	24	7/15–8/30
1/1–2/28	76	24	14	May
Jan.–Feb.	1,361	8	4	May–June
Jan.–Feb.	1,361	8	4	May–June
Jan.–Feb.	1,361	8	4	May–June
5/1–7/15	49	30	30	9/15–12/1
5/1–7/15	49	30	30	Sept.–Oct.
5/1–7/15	49	30	30	9/15–12/1
5/1–7/15	49	30	30	9/1–11/1
5/1–7/15	49	30	30	8/15–10/1
5/1–7/15	49	30	30	8/15–10/1
5/1–7/15	49	30	30	9/1–10/15
Jan.–Feb.	109	20	20	5/1–5/30
Jan.–Feb.	109	20	20	6/1–6/30
2/10–4/15	70	25	25	11/1–6/30
2/10–4/15	70	25	25	11/1–6/30
12/15–3/1	453	12	8	6/10–7/15
12/15–3/1	453	12	8	6/1–6/20
2/1–3/1	453	12	8	6/20–7/15
2/1–3/1	453	12	8	6/20–7/15
2/1–3/1	453	12	8	7/1–7/20
12/15–3/1	453	12	8	6/1–6/20
2/10–4/15	90	22	22	10/1–12/30
2/10–4/15	90	22	22	10/1–12/30
2/10–4/15	90	22	22	10/1–12/1
2/10–4/15	90	22	22	10/1–12/1
1/1–2/28	109	20	20	5/1–6/1
1/1–2/28	43	32	32	5/1–6/1
1/1–2/28	70	25	25	11/1–12/15
2/10–4/15	76	24	24	11/1–2/1
2/10–4/15	76	24	24	11/1–2/1
2/10–4/15	76	24	24	11/1–12/1
Jan. or Feb.	109	20	20	6/15–8/1
Jan. or Feb.	109	20	20	5/15–6/15
Jan. or Feb.	109	20	20	11/1–12/1
Jan. or Feb.	12	60	60	11/1–1/1
Jan. or Feb.	109	20	20	10/1–12/1
Jan. or Feb.	109	20	20	5/15–6/15
Jan. or Feb.	389	14	8	9/1–12/1
Jan. or Feb.	109	20	20	9/1–12/1
10/15–11/15	24,891	42	1	2/20–5/1
Feb.–Apr.	109	20	20	12/15–2/1
Feb.–Apr.	109	20	20	11/15–1/1



LIVESTOCK RAISING

The importance of livestock to the agriculture in the desert area can hardly be overemphasized. The late Dean Hunt of the University of California expressed the fact with the statement that "Any permanent prosperity for agriculture in Imperial County would be founded on livestock." The same can be said for the entire desert area.

Abundant feed of high quality and low cost is the foundation of desert livestock farming.

Crop rotations required for good land management in these areas necessitate keeping approximately one-third of the cultivated areas in alfalfa. Alfalfa (hay and green chopped) is basic to livestock feeding and Sudangrass produces large tonnages of green feed during the summer. Barley or oats (see Field Crops, page 20, will produce green feed from December through the winter. Sorghums (see Field crops, page 29), and early spring-planted field corns produce 15–30 tons silage per acre. Livestock fit naturally into a situation of this kind and in addition to the profits from the industry, there are other benefits to the soil from the alfalfa that is grown and from the manure produced.

BEEF CATTLE—Approximately 350,000 head of beef cattle are brought into the area from all over the west. Most of these beef animals will weigh from 300 lbs. to 600 lbs. on arrival. Due to the large amount of roughage grown here, and the availability of grain and concentrates cattle are both grown out and fed to slaughter finish in the desert area. After finishing, the animals are trucked to the Coastal area for slaughter. Mechanization of harvesting farm-grown feeds, and the mechanization of feeding concentrates, has caused most farmers to keep their cattle in the feedlot from arrival to finish. The number of cattle fed in pasture has materially decreased in the past few years. An acre will produce at least 20% more feed when mechanically harvested than when pastured. Quietness of cattle, ease of detecting disease, ability to more closely regulate rations and ability to use manure on areas where it is most needed, are a few of the many advantages of corral feeding.

Kind of Cattle. All kinds of cattle are brought into the area. The predominate breed is Hereford (White Face). Most of these are of reasonably good quality though the range is very great. A considerable number of Brahman crosses are brought in from the southwest. These at present, are of very mixed breeding and are *not* crosses of pure Herefords and Brahmas ("Brafords"). These mixed Brahman crosses mostly slaughter as "U.S. Standards" and "U.S. Commercial" and very little feeding for "finish" is justified.

Small numbers of other breeds such as Shorthorn, Angus, Santa Gertrudis, Charolaise, Charbray, as well as various cross combinations are to be found in the area.

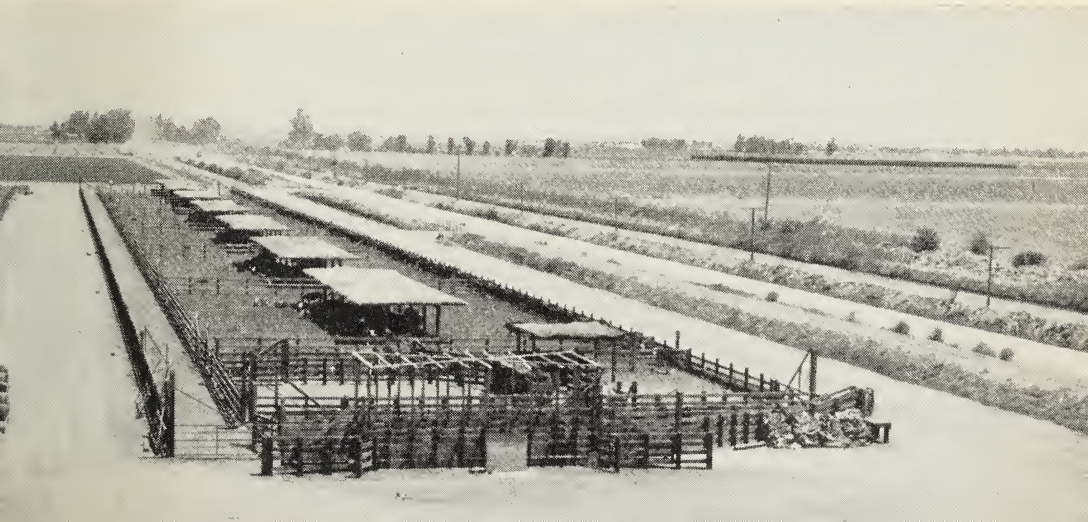
The information in this publication will refer to Hereford type cattle unless otherwise specified.

Breeding Herds. A few relatively small breeding herds are maintained in this area. If good management practices are followed, normal healthy calves can be produced. However, feeding cattle for market is considered the more profitable enterprise.

Cattle operations vary tremendously in size. *Field crops farmers* may feed off-grade (grassy alfalfa) hay, or may pasture alfalfa, cotton, or other crops as a clean-up process with 50 to 200 head and then put them in a commercial feedlot to finish them. The farmers' main income in this case is from the sale of field crops while the cattle utilize material which has little value otherwise. Gains from such salvage type feeding vary from very little to as much as 1.5 lbs. per head per day with perhaps 1.0 to 1.25 lbs. gain per head per day being regarded as good.

Most *livestock farmers* on the other hand have mechanized their operations and handle from 500–2000 head or more per year. In these cases the livestock are used to market part or most of the field crops produced on the farm. Alfalfa is chopped standing in the field, blown into a feed wagon and hauled to the cattle. In the late fall, winter and early spring, a barley or oat crop, planted before October 1st is chopped standing and hauled to the cattle. Hay, straw, silage, rolled grains in many combinations and amounts are included in the feed to increase gains, decrease scouring and bloat, and to give flexibility to the operation. Most of these livestock farmers will keep their cattle in corrals all the time. Again, however, there is a wide variation in operations. Some pasture the cattle for a

A cattle feed lot operated by a livestock farmer in the desert area. Careful planning and arrangement of the pens has enabled the operator to efficiently handle and feed 800 head. Note shade structures provided for the animals.



few weeks or months in alfalfa fields, cotton fields, or on fields planted in the early fall to barley or oats and then put them in the feedlot.

Whether pastured and then put in the feedlot or whether put directly into feedlots, this part of the operation is a "growing" process. Gains of 1.5 lbs. to as much as 2.5 lbs. per head per day may be expected under good conditions.

When the animals reach 700–800 lbs. the livestock farmer may "finish" them in his own corrals or he may put them in a commercial feedlot in the area.

"Finishing" cattle is that portion of the operation where cattle are brought to a higher slaughter grade. Both livestock farmers and commercial feedlots in the area finish cattle. The commercial feedlots offer many choices of feeding arrangements to the livestock man. They may contract with farmers to feed cattle at a specified price per pound of gain, or per ton of feed used, or at a given rate per day. The cattle may belong to the feedlot operator, to the range cattlemen or to others. The commercial feedlot will buy or arrange for some customer to buy cattle from a livestock farmer that are ready to be finished, or they will feed out cattle to a higher slaughter grade, for the farmer.

Cattle being finished are fed a ration of ground or rolled grain (barley, milo, corn, etc.), mixed with a good quality protein feed (good alfalfa hay, protein meals, etc.) along with hays or straws. Many different kinds of mixes are used with success. Most cattle being "finished" are now receiving growth stimulating hormones. Expected gains during the finishing period will range from 2.0 lbs. to 3.0 lbs. per head per day.

General Observations of Beef Cattle in the Desert

Most of the cattle are brought into the area during the late fall and winter though some are brought into the area nearly every month in the year.

Weighing conditions are very important—at time of purchase and sale and in calculating gains. Most purchases are made by "standing" the cattle for an hour, weighing, and then deducting 4% as "shrink." However, in most recognized *tests* the cattle are kept from feed and water overnight and weighed in the early morning.

Amounts of green roughages for feeding should be calculated to dry matter—for instance, the following green feeds have about the indicated per cent dry matter; alfalfa 25 per cent, barley 20 per cent, corn silage 27 per cent, Hegari silage 35 per cent, etc. In calculating feed requirements many people use 3.0 lbs. "dry matter" (roughage feeds) per 100 lbs. body weight per day because most hays and straws actually have about 10 per cent moisture in them. This information is useful to the inexperienced livestock farmer in matching up his feed with the number of cattle he can handle.

Shade is a *must* for cattle in the summer. Tests at the University of California Imperial Valley Field Station indicate a satisfactory shade should be about 12 ft. high and that there should be about 60 sq. ft. of shade per animal. Hay or brush laid over wire netting is excellent.

Corral area of 125–150 sq. ft. per animal is desirable. Some cattlemen only allow 85–100 sq. ft. per animal, however, some problems are presented with this smaller area, particularly in bad weather. Two lineal feet of trough feeding space is allowed per animal by most livestock men.

Cool water is another *summer must* for good gains. The water temperature should be in the low 70's. Pumped water and water cooled by evaporation in water towers are being used in the area. The water troughs should be shaded with just enough shade to cover the trough—otherwise the animals use it for a shade. Shallow 8 inch troughs will furnish water that averages 5° F cooler than tanks with a 30 inch depth of water. During the

summer, beef cattle will drink 10–15 gallons per head per day.

Moving air over the cattle in the summer has increased gains according to recent research at the University of California Imperial Valley Field Station. Wire cable, or heavy woven wire corrals are much cooler than board fences. Large fans to move air across corrals on quiet days are showing some promise of increased gains.

Summer rations of cattle fed with roughages and concentrates (alfalfa hay, ground or rolled grains, etc.) produced gains of from .4 to .5 lbs. more per head per day than did those fed roughage (alfalfa hay) alone. Cattle receiving hay, grain and cool water made 2.01 lbs. per head per day while the hay, cool water lot gained 1.51 lbs. Both groups of cattle started at approximately 850 lbs. The hay-concentrate group were fed approximately 8.7 lbs. per head per day of a mixture of barley, milo and beet pulp and 10.8 lbs. alfalfa hay. This test was conducted by the University of California Imperial Valley Field Station in cooperation with the Division of Animal Husbandry and U.S. Department of Agriculture.

Income and Cost. A study by Utah Agricultural Experiment Station (Bul. 380) shows the following percentage distribution of gross receipts from sale of fat cattle; cost of cattle 49.9 per cent, feed 29.6 per cent, labor 4.1 per cent, overhead 3.6 per cent, materials, power, etc. 2.6 per cent net return 10.2 per cent.

SHEEP. Some 200–300,000 feeder lambs are brought into the low desert area each fall and early winter. About November 1 is regarded as a good date to have the lambs arrive. The desirable purchase weight is 50–70 lbs. Blackfaced lambs are generally preferred.

Lambs are put into bands of 1500 or more and put in charge of a herder or herders. Because dogs are a constant menace some portable sheep wire fencing is used for field fencing. Bloat is a hazard that must be constantly guarded against. Usually bloat only occurs on alfalfa or other green legume forages. Dry hay scattered out through the field is a good preventative. Cattlemen often "move" bloaty cattle to get them to expel the accumulated gas. Sheep usually die when "moved." Liberal feeding of carbohydrates, feeds such as barley or molasses, or of hay, seems to prevent loss from "stiff lambs." *The greatest losses from all causes usually occur during the first 30 days after arrival. Dry hay, grassy pasture, mature green alfalfa or other*

Large numbers of feeder lambs are imported into the desert region and fattened on winter pasture for spring markets. Ewes are imported, lambed out and the milk-fed lambs are marketed. The ewes are fattened and marketed or shipped back to the range.

Big litters and alfalfa pastures reduce the cost of raising weaner pigs and maintaining sows in the desert area. Farrowings are spaced to avoid the extreme high temperatures of summer. Housing is not important but shade is essential.

"poor" quality pasture during this period often reduces losses.

The lambs are pastured on green feed during most or all of the 4–5 months before they are sent to market. Occasionally some supplemental feeding is done. Alfalfa alone is most widely used. A cereal-alfalfa mixed pasture is generally regarded as very good. The lamb owners rent nearly all of the pasture for their lambs on a head-day basis.

Gains vary widely but 7 lbs. per lamb per month is an average. Gains up to 12 lbs. per lamb per month have been reported. Many of the lambs have some wool on them when they arrive. Four to 5 lbs. of wool is usually sheared from a lamb about 70 days prior to marketing. The western market has shown a preference for lambs weighing from 90–105 lbs. live weight. The lambs are sent to market from January through April with the largest number being moved in February and March.

Ewes in relatively large numbers are brought into the area in the fall and are lambed out. The lambs are dropped in the fall and are marketed in the spring as milk fat lambs. The ewes are fattened and sold in the late spring or are taken back to the range. Some bands of dry ewes are brought in to the area in October, fattened on pasture, and then sent to market.

A few bands of ewes are kept on a year-around basis in the area. They require shade, cool water, and must be sheared as hot weather starts. Ewes are ordinarily sheared twice a year—about October and May. The total wool produced is about 12–14 lbs. per ewe. Three to 4 bucks per 100 ewes are put with the ewes about June 1st for November lambs.

DAIRYING in southern California has had a tendency to move closer to the larger centers of population, but some dairies in the desert region have put in the necessary buildings and equipment for producing Grade A milk. Production of churning cream has disappeared in the area.

There are both advantages and disadvantages to dairying in the desert. The desert area has an abundance of comparatively cheap roughage feed and green feed can be available during most of the year. Many feel that the comparatively cheaper feed for the producing

herd, plus an excellent market on the coast for heifers and cows, more than compensate for the disadvantages of the area. Many producing herds in the area have exceeded 300 pounds of butterfat per cow per year without the use of concentrates. The disadvantages are the long hot summers and present lack of adequate transportation for fluid Grade A milk to coastal markets.

At the present time this area must import all but a small part of the fluid Grade A milk it uses and practically all of the milk products.

Undoubtedly by using all the information available the marked reduction in milk production that occurs in the summer can be reduced. In addition, milkers and others handling the cows and the milk can be made more comfortable during the summer. All these things must be done before dairying can be considered as a major desert enterprise.

The production of replacement cows for the large coastal dairy cow replacement market offers considerable opportunity in the area.

SWINE production has been a modest sized industry in the desert region. The area is particularly fortunate in having an excellent hog market nearby and this advantage can probably be maintained for a long time because over half of the pork consumed in California is still being brought in from the midwest.

The heat has never been a serious handicap in pork production when an abundance of water has been provided for both drinking and wallows. While housing requirements are nominal, due to the mild weather, shade sheds or shade trees are essential.

Farrowings should be spaced to avoid pigs coming during the hottest part of the summer. A considerable number of feeder pigs weighing from 35–60 lbs. are sold in the Los Angeles and San Diego areas, mainly to garbage feeders.

Gains made during University of California Imperial Valley Field Station swine feeding test from July 21 to November 15, 1955 using swine weighing approximately 48 lbs. produced gains up to 1.57 lbs. per head per day up to slaughter weight of 231 lbs. A ration using 5% ground alfalfa hay, grain, and protein concentrates was compared with a ration using 30% ground alfalfa hay with the rest being grain and protein concentrates. The low hay, high grain and protein concentrate rations gave the greatest average daily gain and the lowest cost per pound of gain. Swine in contrast with beef cattle and sheep are a means of marketing grains and other concentrate feeds rather than roughage.

CHICKENS AND TURKEYS

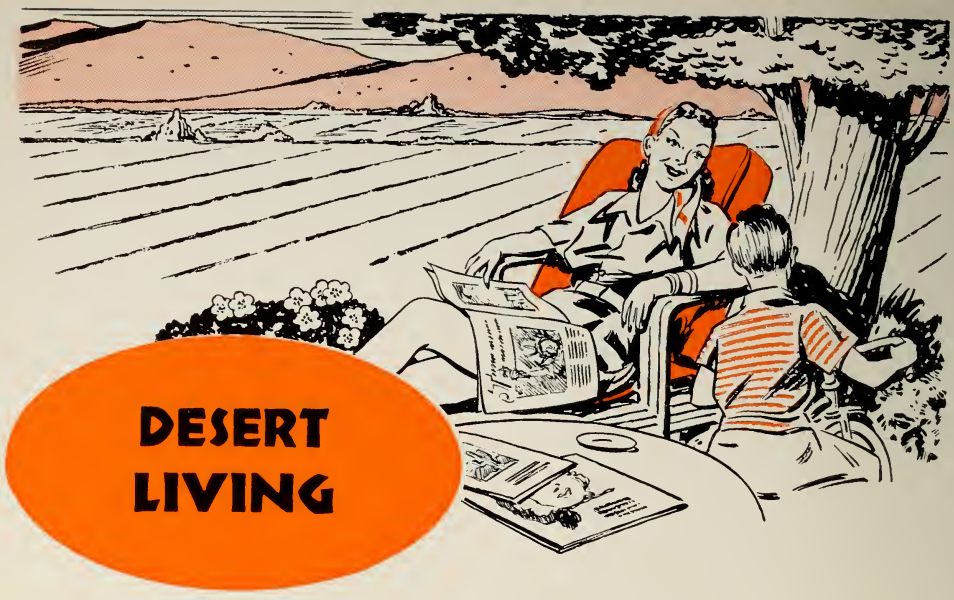
Very few egg-laying flocks are kept in the low elevation desert area. Summer heat, even when cooling aids are used, lowers egg production in comparison with other areas of the state.

Broilers and fryers can be satisfactorily produced in the area but due to summer heat there are very few commercial operations. Most broilers and fryers are raised from early fall to late spring.

Turkeys can be sucessfully grown in the low desert area but there are no special advantages.

RABBITS

It has been very difficult to keep rabbits through the hot summer months. Heavy death loss due to heat usually occurs in spite of good management.



Living in a desert climate is extremely pleasant during the cooler months. The extreme summer heat however, creates a number of problems unique to the desert. To temper summer's heat, local residents have universally adopted air conditioning for homes, schools, and places of business. The desert (evaporative) type cooler or the more expensive refrigerative type air conditioners, are everywhere in evidence. Homes, schools, and other buildings are cool inside no matter what the temperature outside.

Landscaping for temperature and wind control also adds greatly to human comfort. Lawns reduce radiation as well as glare. The most common lawn grass is Bermudagrass. Other ground covers used extensively are Lippia and St. Augustinegrass. Winter lawns of Annual Ryegrass are common and these may be seeded into Bermuda with good success. The area to be planted should be renovated before the Ryegrass is seeded.

Trees, shrubs, and flowers of many types, can be grown but many varieties will not thrive. The plants listed following are the ones which are at present most commonly used in this desert area. The list was taken from Cal. Agr. Exp. Sta. Bul. 750, which may be obtained at most libraries throughout the state.

SHADE AND ORNAMENTAL TREES

Acacia, Blackwood (*Acacia melanoxylon*)
Arbor-vitae, oriental (*thuja orientalis*)
Ash-Arizona (*Fraxinus velutina*)
Athel tree (*Tamarix aphylla*)
Beefwood (*Casuarina stricta*)
Bottle tree, Australian (*Brachychiton populneum*)
Carob, St. John's Bread (*Ceratonia siliqua*)
Chinaberry tree (*Melia azedarach*)
Citrus—grapefruit, tangerine, orange, etc.
Cottonwood (*Populus fremontii*)
Cypress, Arizona (*Cupressus glabra*)
Cypress, Italian (*Cupressus sempervirens*)
Date Palm (*Phoenix dactylifera*)
Elm, Siberian (*Ulmus pumila*)
Elm, Chinese Evergreen (*Ulmus parvifolia*)
Eucalyptus, desert gum (*Euc. rudis*)
Eucalyptus, gray or slaty gum (*Euc. tereticornis*)
Eucalyptus, red iron bark (*Euc. sideroxylon*)
Eucalyptus, red gum (*Euc. camaldulensis, E. rostrata*)
Fig (*Ficus carica*)
Firefall tree (*Callistemon viminalis*)
Jacaranda (*Jacaranda acutifolia*)
Jerusalem thorn, Palo Verde (*Parkinsonia aculeata*)
Juniper, Pfitzer (*Juniperus chinensis*)
Locust, black (*Robinia pseudo-acacia*)

Mulberry, fruitless (*Morus species*)
Oak, silk (*Grevillea robusta*)
Olive (*Olea europaea*)
Pine, Aleppo (*Pinus halapensis*)
Texas umbrella tree (*Melia azedarach umbraculiformis*)

DESERT NATIVE TREES & SHRUBS

Cactus—varieties
Cottonwood, Valley (*Populus fremontii*)
Mesquite (*Prosopis glandulosa*)
Palm. California fan (*Washingtonia filifera*)
Palo Verde (*Cercidium torreyanum*)
Palo Verde, Jerusalem thorn (*Parkinsonia aculeata*)
Willow, desert (*Chilopsis linearis*)

PALMS

Canary Island palm (*Phoenix canariensis*)
Date palm (*Phoenix dactylifera*)
Fan palm, California (*Washingtonia filifera*)
Fan palm, Mexican (*Washingtonia robusta*)

SHRUBS

Acacia, sweet or Huisache (*Acacia farnesiana*)
Bamboo, Heavenly (*Nandina domestica*)
Bird of paradise bush (*Polinciana gilliesii*)
Bridal wreath (*Spiraea vanhouttei*)
Cassia, wormwood (*Cassia artemisioides*)
Crapemyrtle (*Lagerstroemia indica*)
Euonymus, Japanese (*Euonymus japonicus*)
Hibiscus
Leadwort (*Plumbago capensis*)
Monks pepper (*Vitex negundo heterophylla*)
Myrtle, common (*Myrtus communis*)
Natal plum (*Carissa grandiflora*)
Oleander (*Nerium oleander*)
Oleander, yellow (*Thevetia peruviana*)
Pigeon berry (*Durante repens*)
Pittosporum, Japanese (*Pittosporum tobira*)
Pomegranate (*Punica granatum*)
Privet, California (*Ligustrum ovalifolium*)
Pyracantha, firethorn (*Pyracantha species*)
Tamarix, feathery pink (*Tamarix tetrandra*)
Texas ranger (*Leucophyllum frutescens*)
Turk's cap (*Malvaviscus arboreus*)

Until recently this fertile farmland was desert waste. Water from the Colorado River delivered by farmer-owned irrigation districts has made this change possible. Farms range in size from 80 to several thousand acres. Desert topography permits regularly laid out fields.

VINES

Bougainvillea
Golden shower (*Pyrostegia ignea*)
Grape, varieties (*Vitis vinifera*)
Honeysuckle, Cape (*Tecomaria capensis*)
Honeysuckle, Japanese (*Lonicera japonica*)
Ivy, English (*Hedera helix*)
Jasamine (*Jasamine species*)
Jasamine, Star (*Trachelospermum jasminoides*)
Morning glory (*Ipomoea purpurea*)
Passion vine (*Passiflora edulis*)
Rosa de Montana (*Antigonon leptopus*)
Rose, climbing (*Rosa species*)
Sweet pea, annual (*Lathyrus odoratus*)
Trumpet vine (*Campsis radicans*)
Virginia creeper (*Parthenocissus quinquefolia*)
Wistaria (*Wistaria sinensis*)

MISCELLANEOUS

Canna (*Canna species*)
Castorbean (*Ricinus communis*)
Giant reed (*Arundo donax*)
Joseph's coat (*Amaranthus tricolor*)
Mexican fire-plant (*Euphorbia heterophylla*)
Pampas grass (*Cortaderia selloana*)
Periwinkle (*Vinca rosea*)
Roses (*Rosa, species*)

FLOWERS

Ageratum
Alyssum, sweet (*Lobularia maritima*)
Aster
Baby blue eyes (*Nemophila menziesii*)
Balsam (*Impatiens*)
Candytuft (*Iberis amara*)
Canna
Carnation (*Dianthus caryophyllus*)
Chrysanthemum (*Chrysanthemum morifolium*)
Clarkia (*Clarkia*)
Cockscomb, feather (*Celosia argentea*)
Coneflower (*Rudbeckia*)
Cosmos
Daisy, African blue (*Arctotis stoechadifolia var. grandis*)
Daisy, English (*Bellis perennis*)
Daisy, Shasta (*Chrysanthemum maximum*)
Datura (*Datura*)
Flax (*Linum*)
Forget-me-not (*Myosotis*)
Gaillardia
Gladiolus
Godetia
Hollyhock (*Althaea rosea*)
Ice plant (*Mesembryanthemum spp.*)
Iris
Larkspur (*Delphinium ajacis*)
Love-in-a-mist (*Nigella damascena*)
Lupine (*Lupinus*)
Marigold pot (*Calendula officinalis*)
Marigold, winter cape (*Dimorphotheca sinuata*)
Mignonette (*Reseda odorata*)
Nasturtium (*Tropaeolum majus*)
Nemesia
Pansy (*Viola tricolor var. hortensis*)
Petunia
Phlox
Poppy, California (*Eschscholtzia californica*)
Portulaca
Ranunculus
Sage, flowering (*Salvia*)
Snapdragon (*Antirrhinum*)
Stocks (*Matthiola*)
Summer cypress (*Kochia scoparia*)
Sunflower (*Helianthus annuus*)
Sweet pea (*Lathyrus odoratus*)
Verbena
Violet, sweet (*Viola odorata*)
Wallflower (*Cheiranthus cheiri*)
Zinnia

ACKNOWLEDGMENTS

The writers desire to express their appreciation for the assistance of a large number of persons who supplied information or data for this publication. The following have been especially helpful:

D. D. Halsey, W. M. Lawson and D. G. Addis, Farm Advisors, Riverside County; Harold Thurber, Robert A. Korsten, Farm Advisors, Imperial County. Fisk Phelp and Andrew S. Deal, Extension Specialists; R. F. Kasmire and C. Harvey Campbell, Farm Advisors in the area.

Many of the recommendations in this publication are based on research findings of the Imperial Valley Field Station University of California; Southwest Irrigation Field Station, U.S.D.A., and U. S. Salinity Laboratory, U.S.D.A.

Co-operative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture co-operating. Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914. George B. Alcorn, Director, California Agricultural Extension Service.

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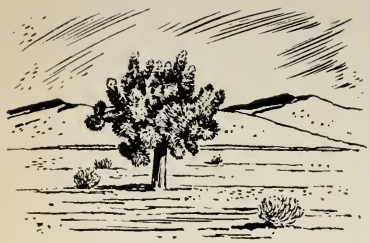
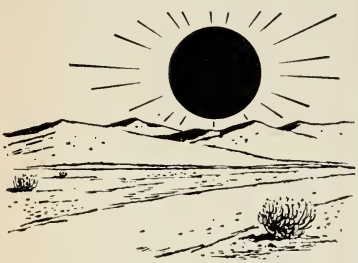


THE CALIFORNIA DESERT

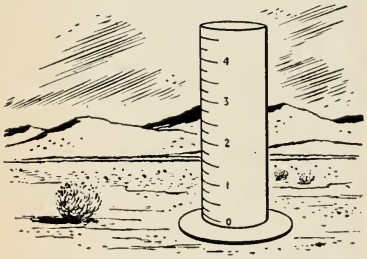
The vast region is located in the extreme southeast corner of California. Bordered on the east by the Colorado and on the south by Mexico.

To the west lay the great population centers of the West Coast and to the north the southern end of the Sierra Nevada. In the past it was dry and barren, producing cactus, sagebrush and little else, the home of Indian and gold prospector. Today, with water it is an increasingly important agricultural area.



IT'S HOT

Temperatures soar in the desert. In the middle of the summer maximum temperatures have been as high as 125°F. From March to October readings of 100°F or higher may be expected. Even in the winter the temperature has risen to 85°F. The winters are short and mild with few if any days of frost. Low humidity makes the heat bearable.



IT'S DRY

Without wells or water brought into the area from the Colorado the desert is parched. Rains are irregular. In many years no rain has been recorded in any part of the desert. The rainfall average is between two and three inches annually. The rains are seldom of benefit to crops and quite often harmful.

IT'S FERTILE . . .

Unbelievably so . . . if irrigated. The soils are mostly deposits from the Colorado River. For the most part the soils are sandy and hold water poorly but they range from heavy clays to pure sand when the whole region is considered. Irrigated crops produce remarkably well.

THIS CIRCULAR . . .

describes the desert region, the crops grown there and the techniques used to grow them. It provides a basic guide for anyone interested in farming in the desert.